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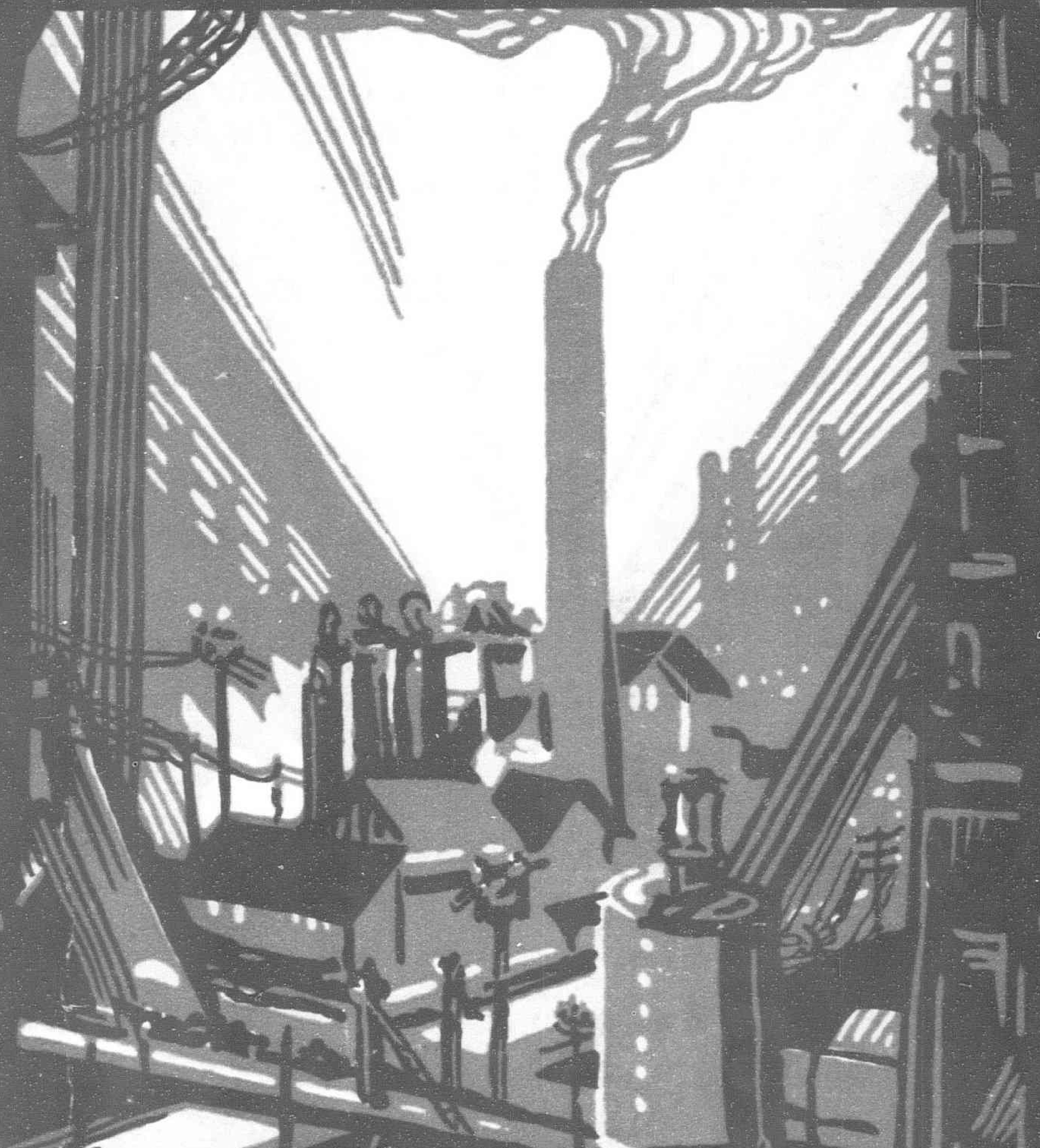

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JAPAN'S POSITION IN THE CONFLICT

JAPAN'S ECONOMIC STRENGTH

CHANGING SIAM

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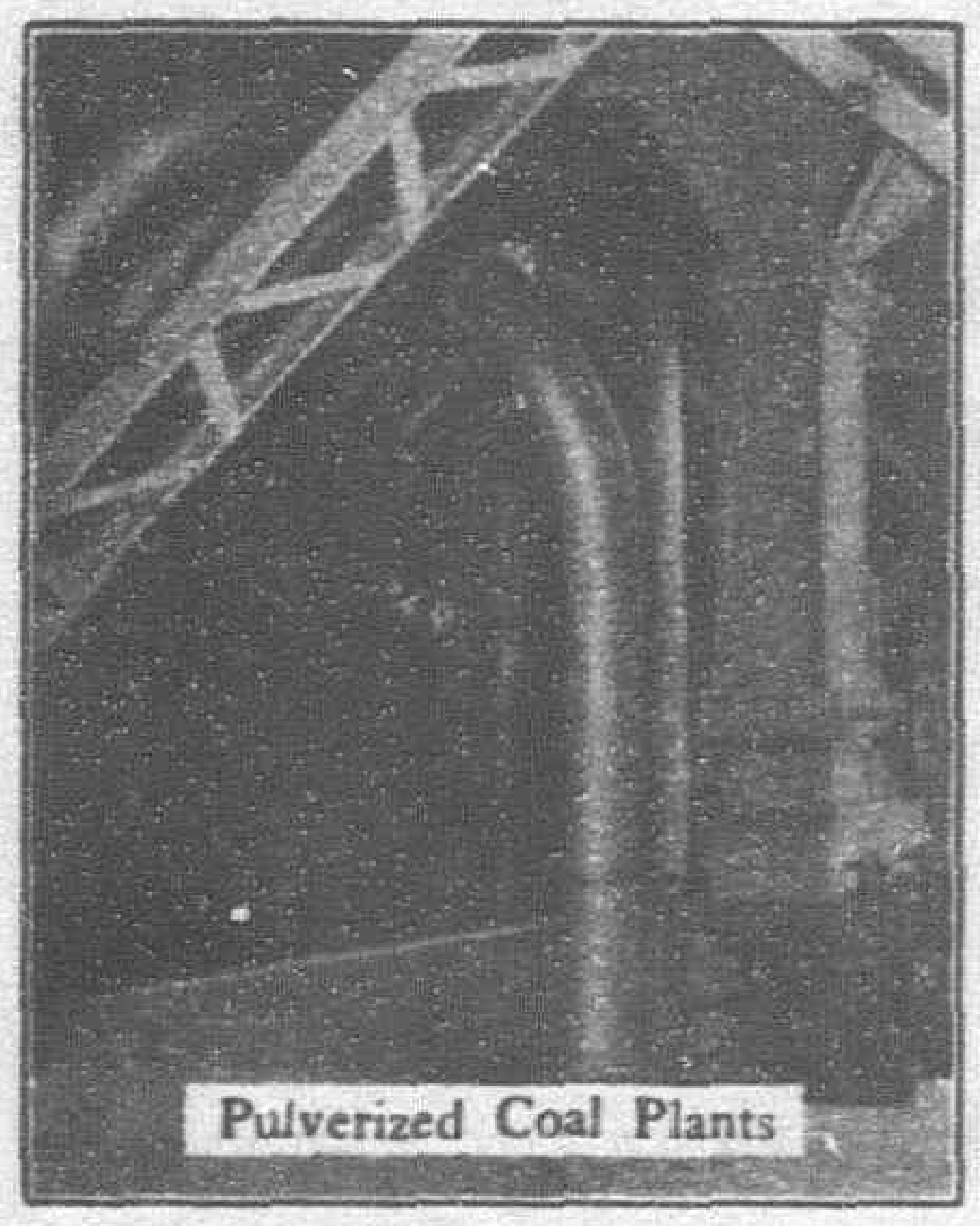
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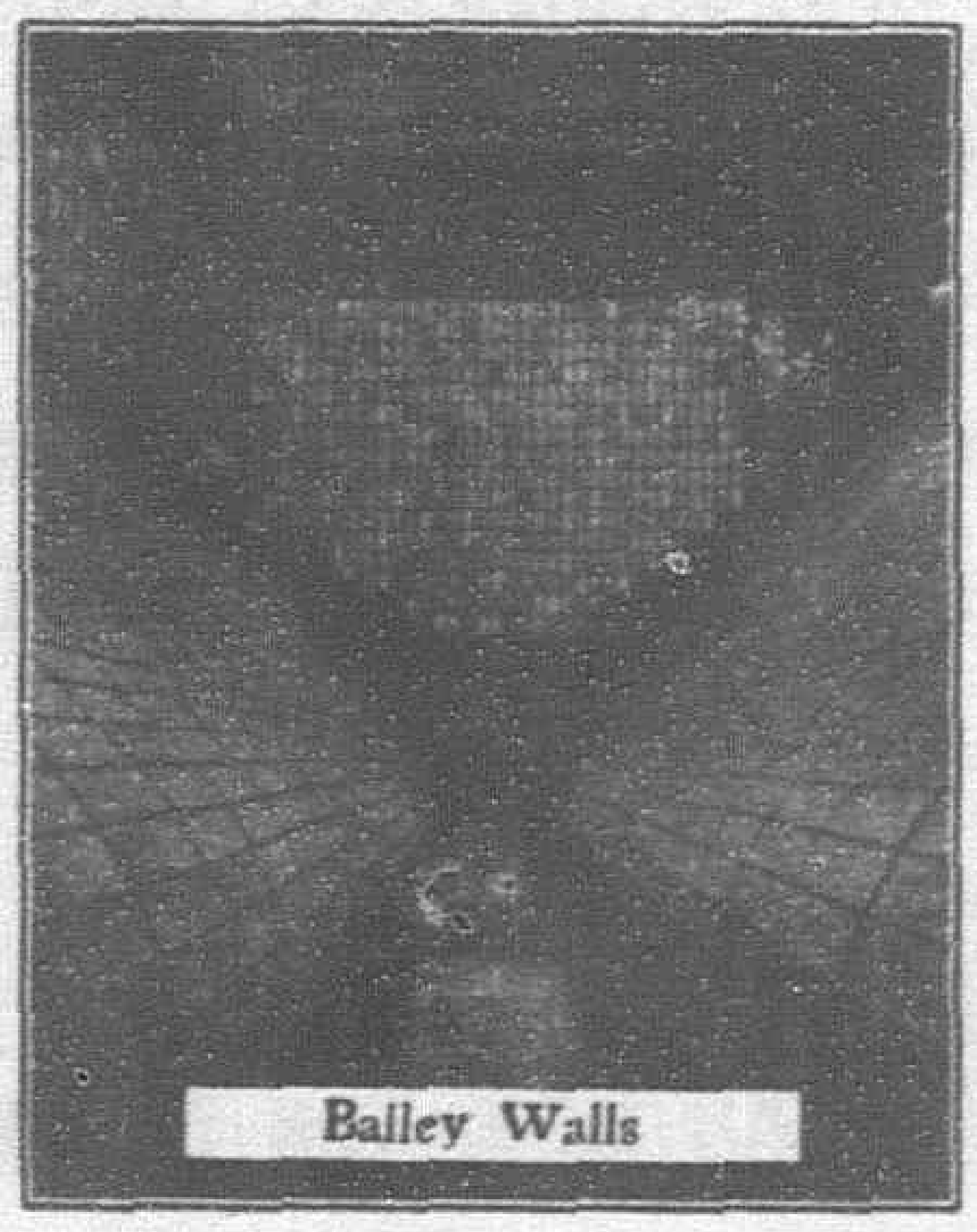
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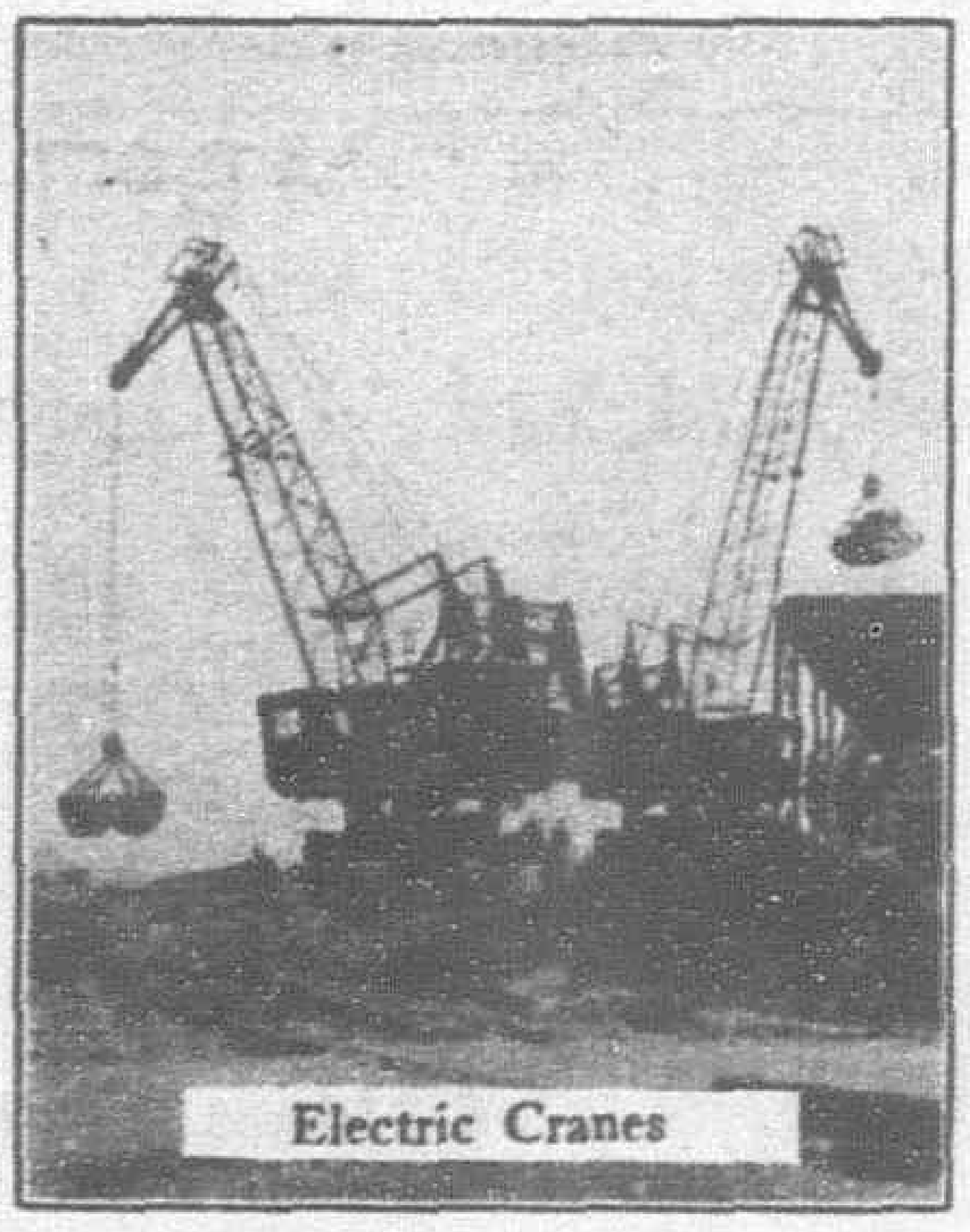
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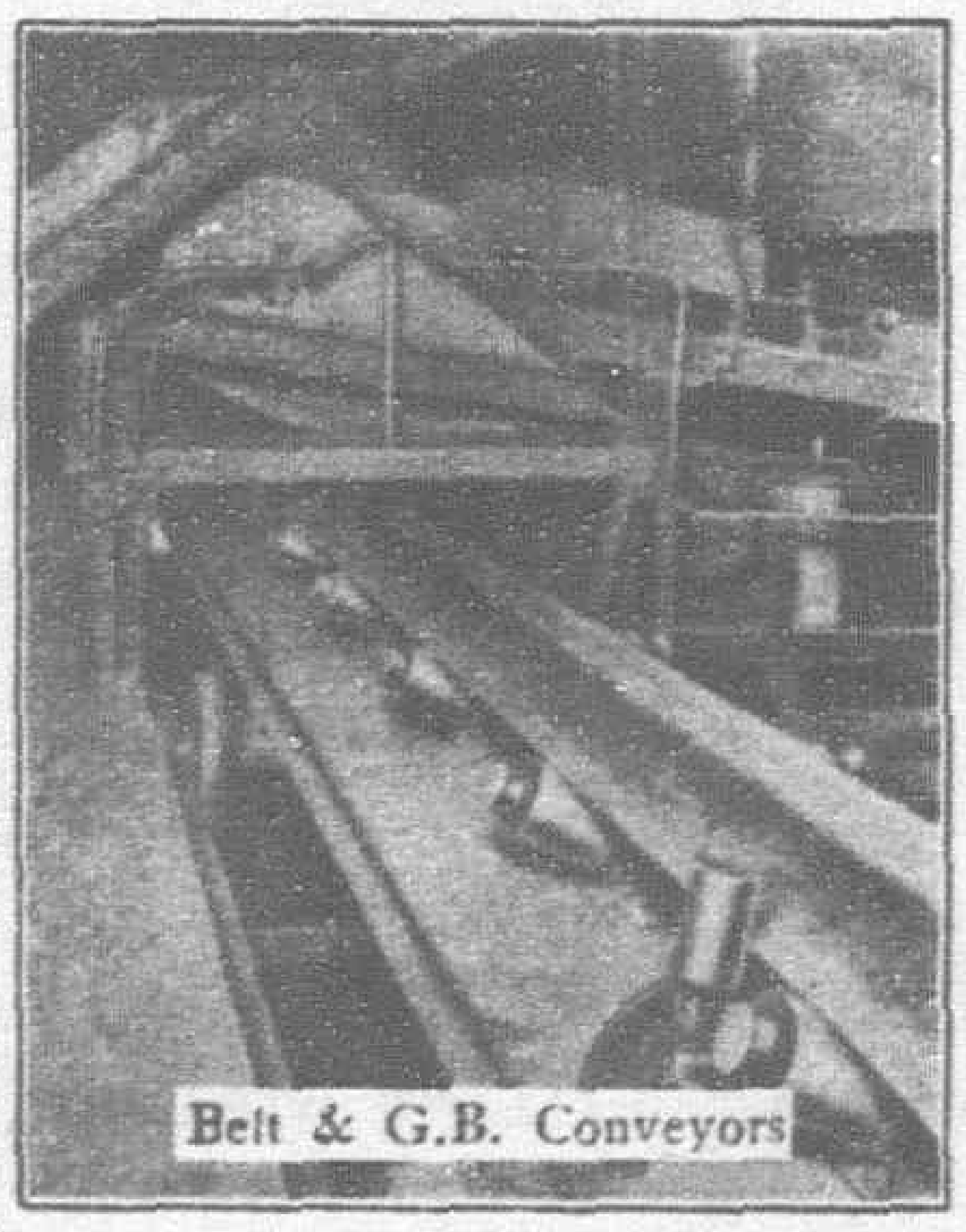
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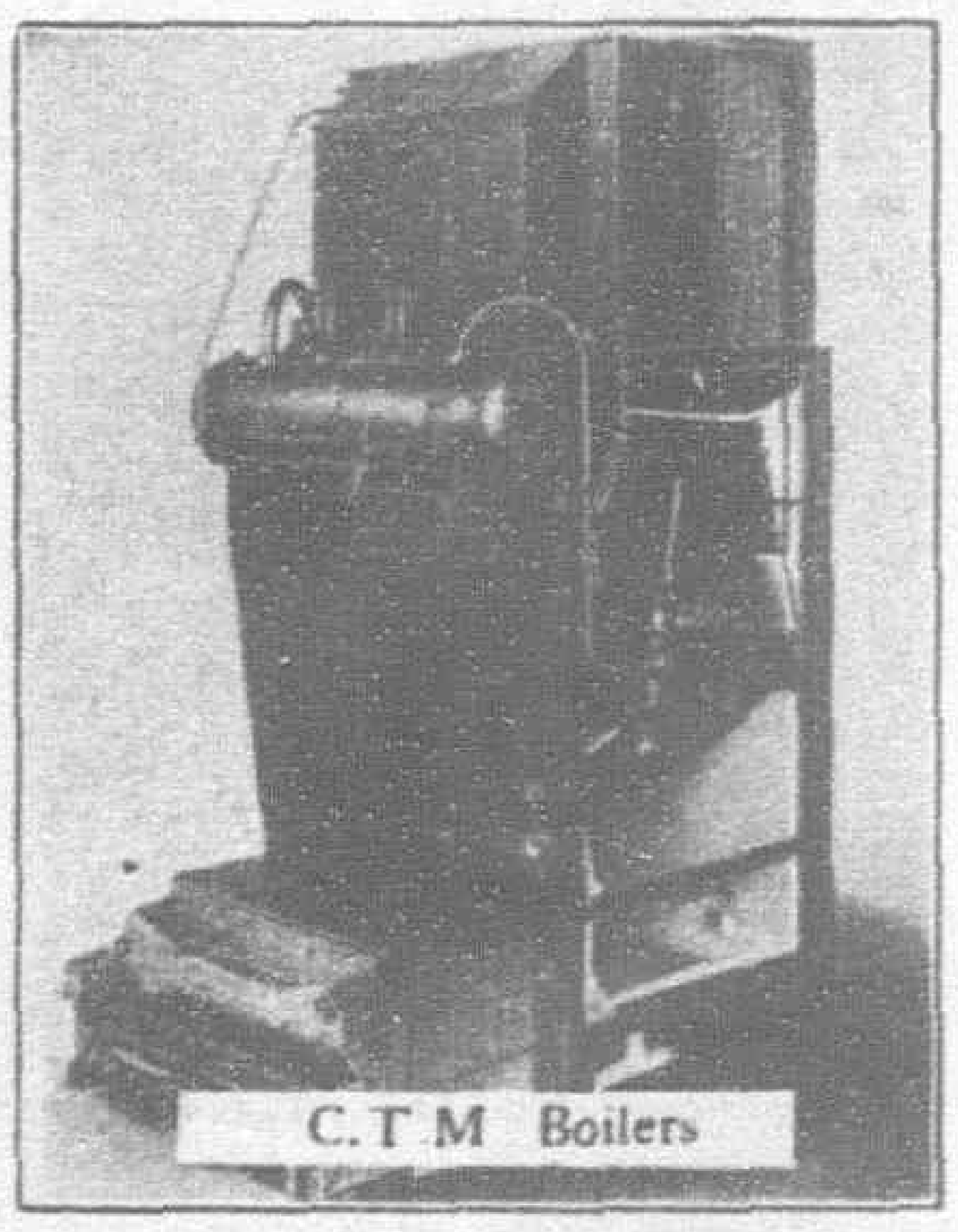
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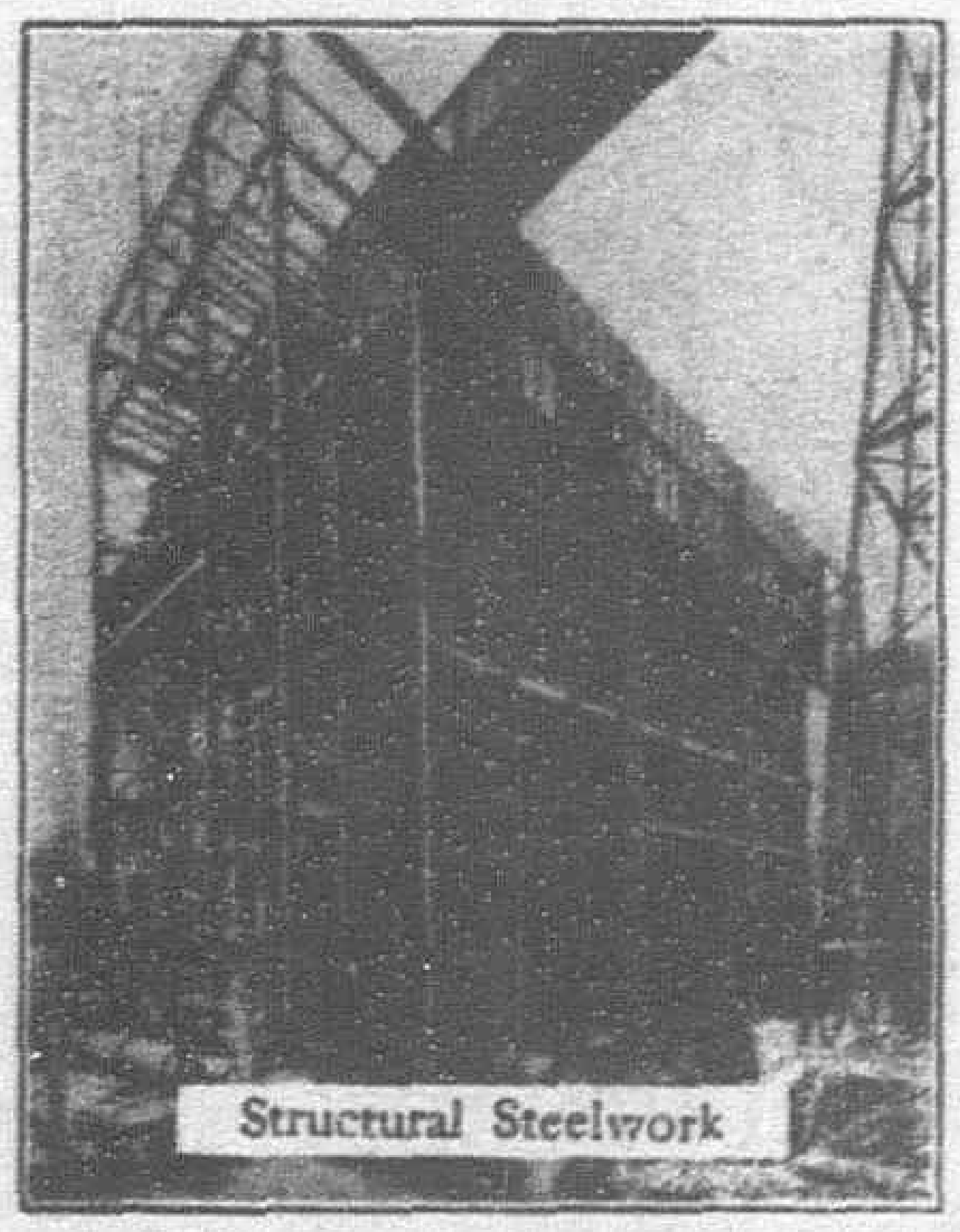
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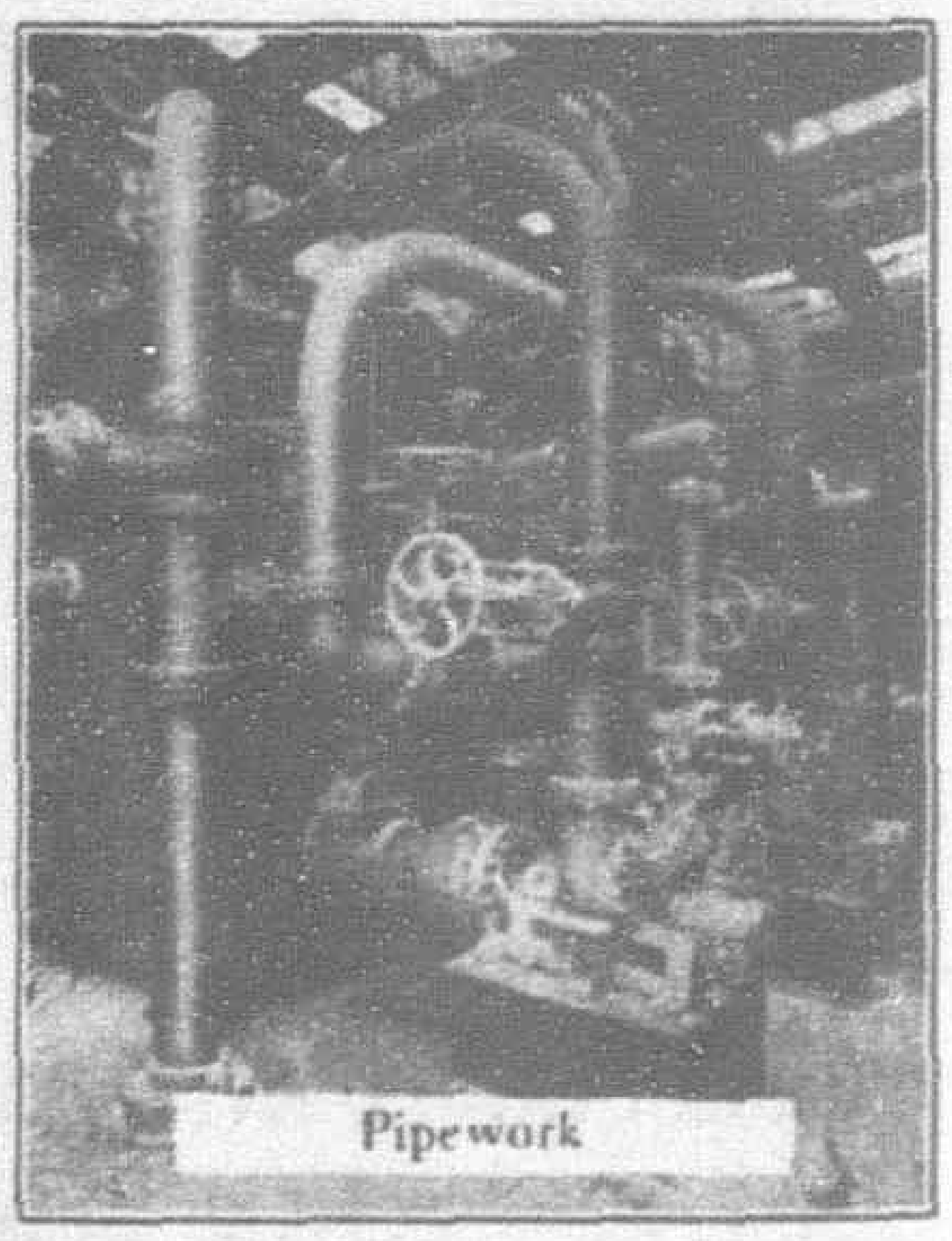
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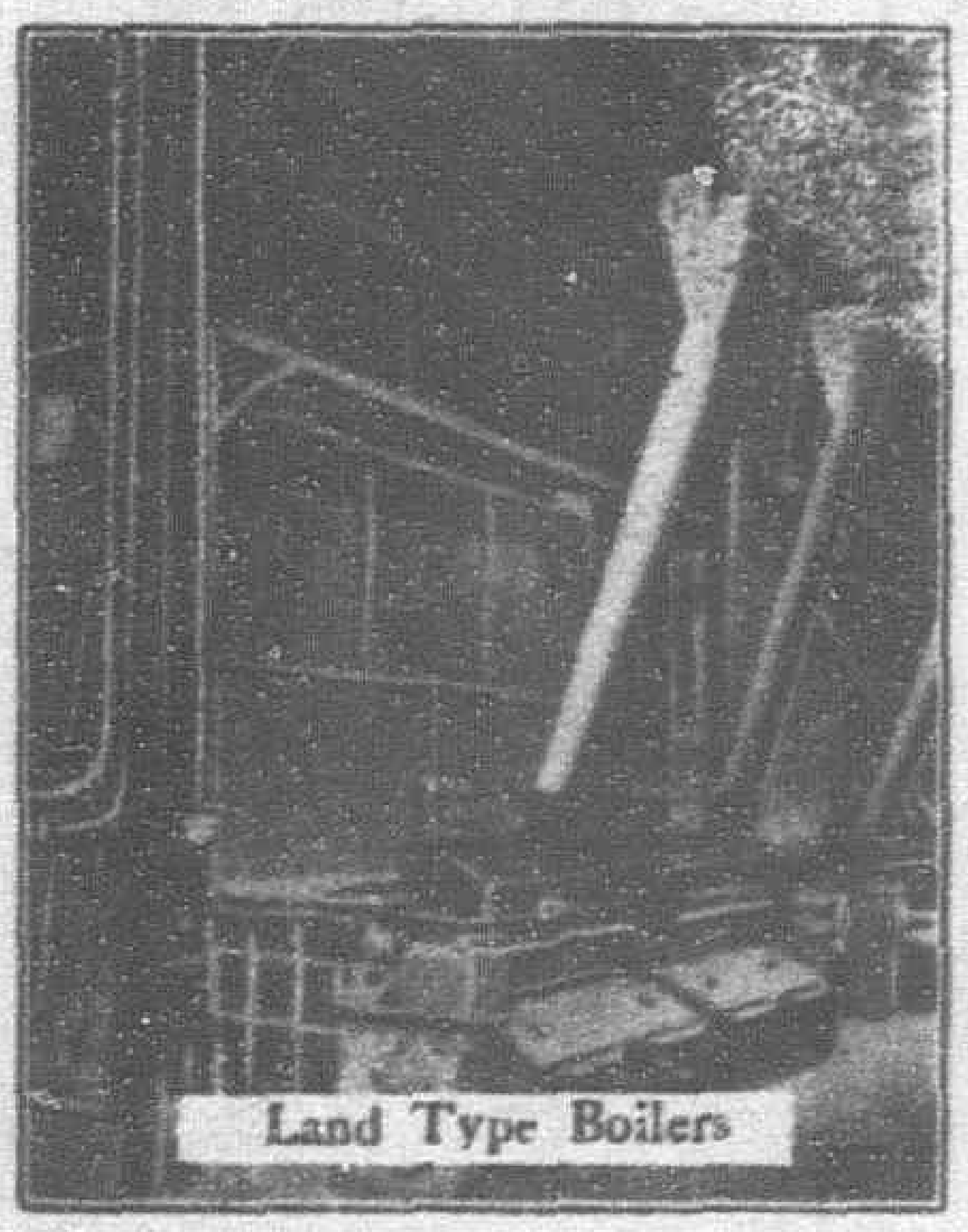
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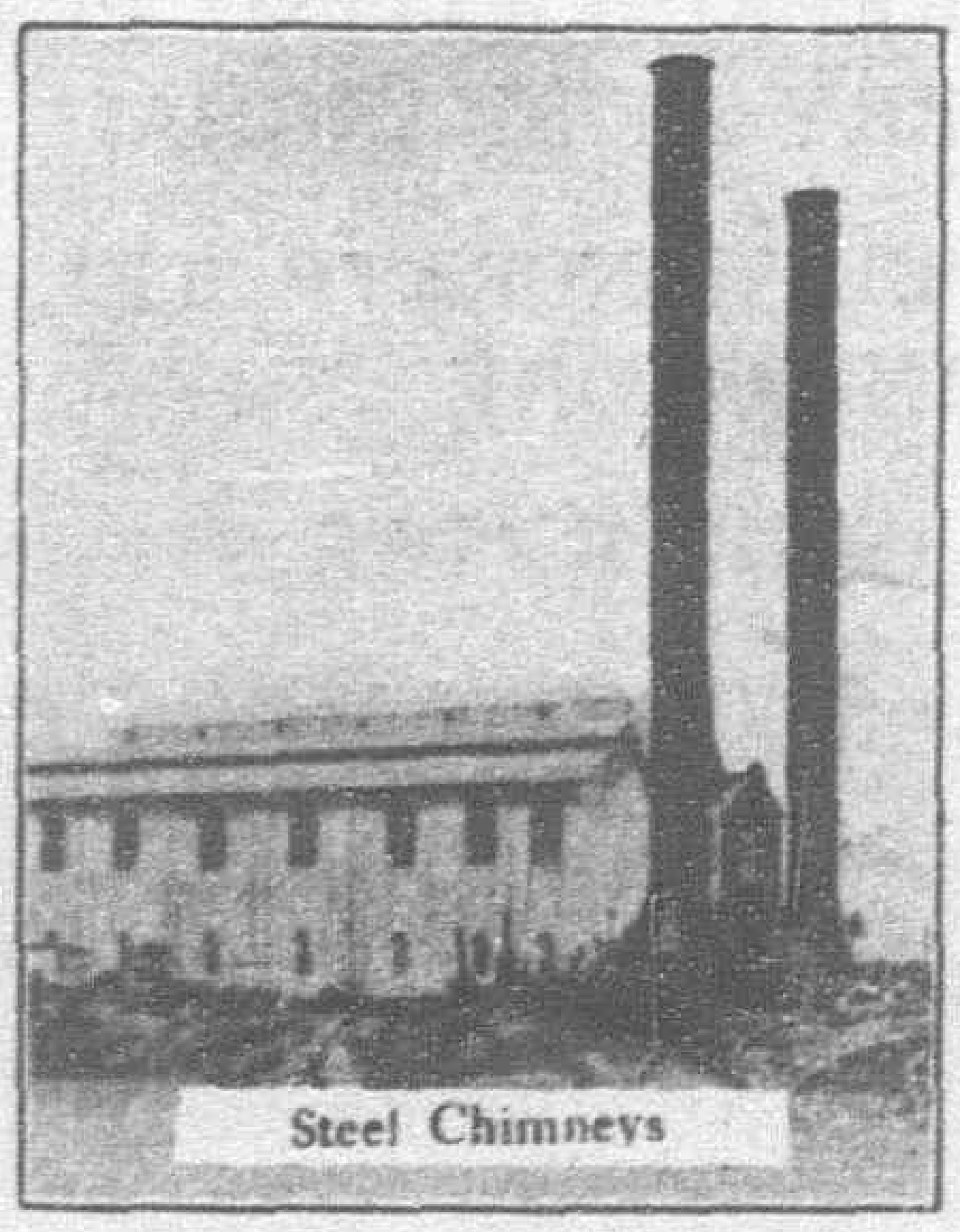
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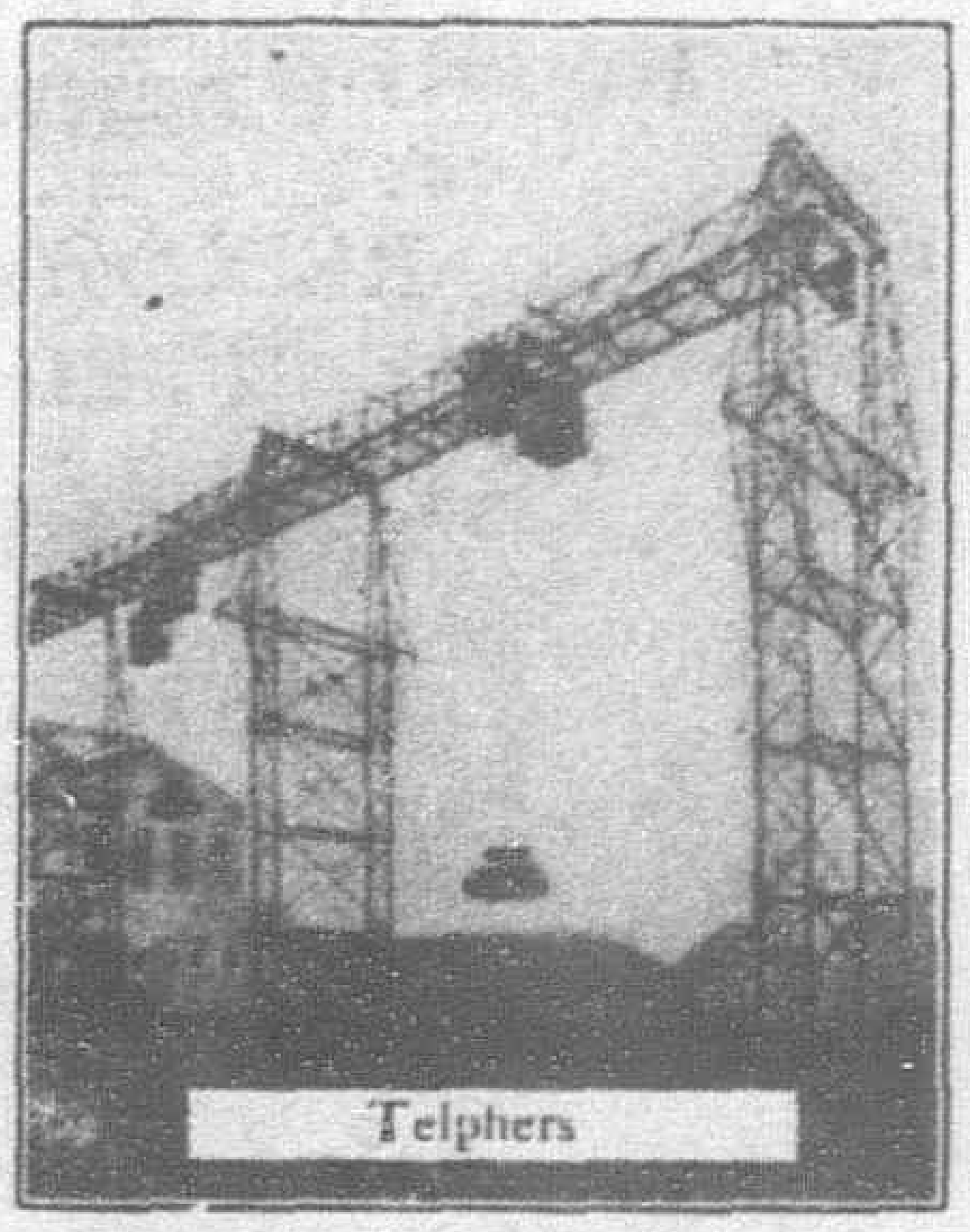
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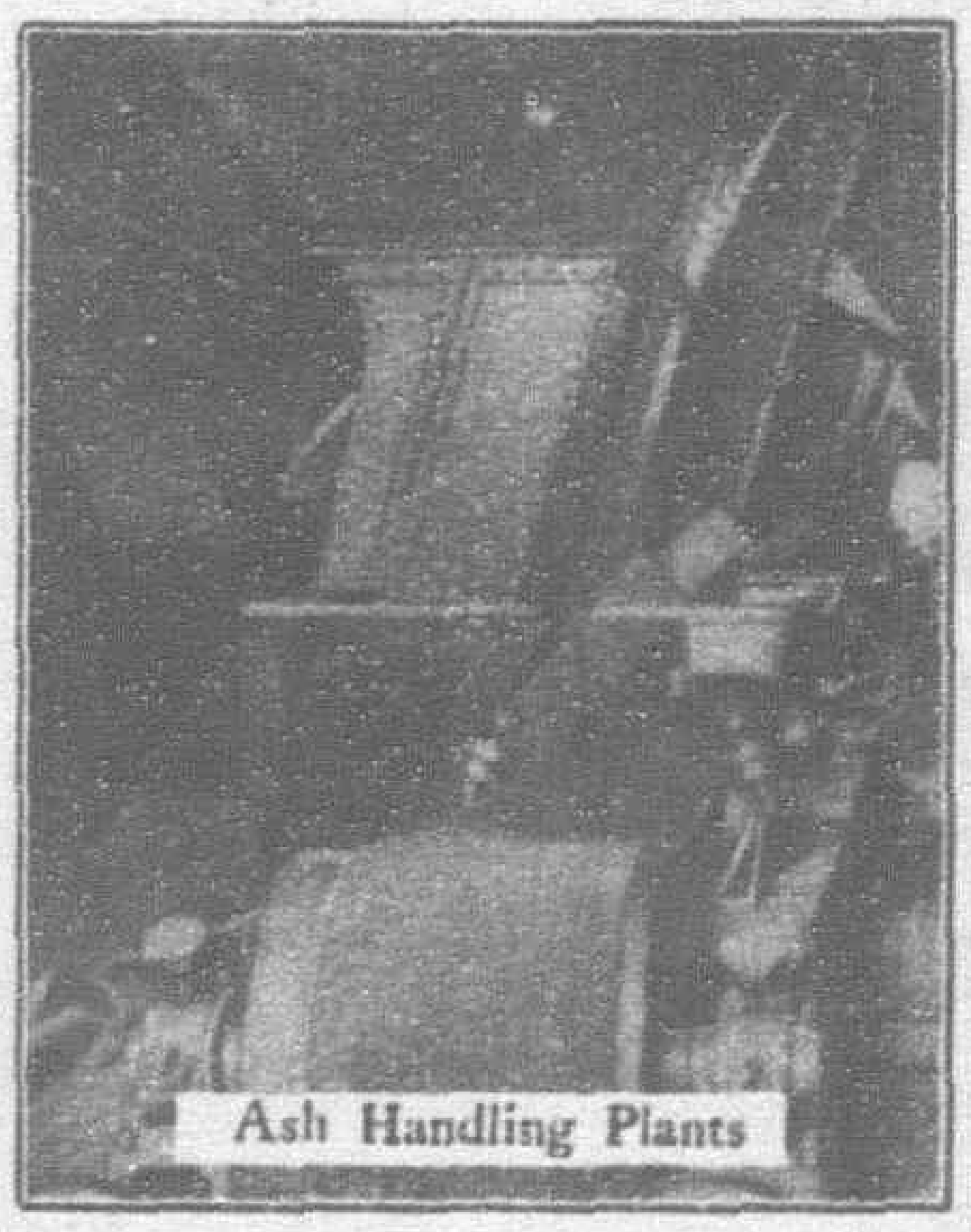
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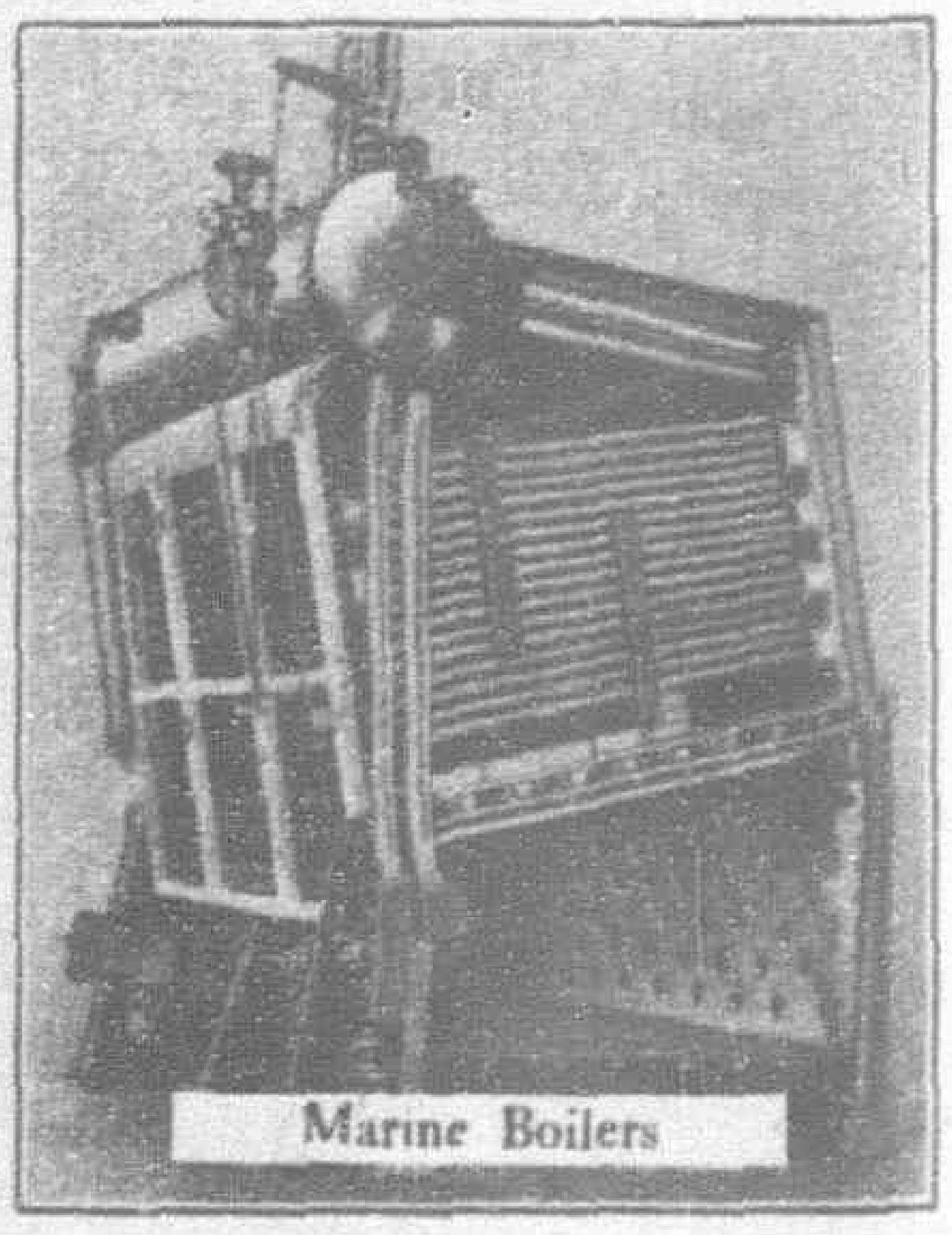
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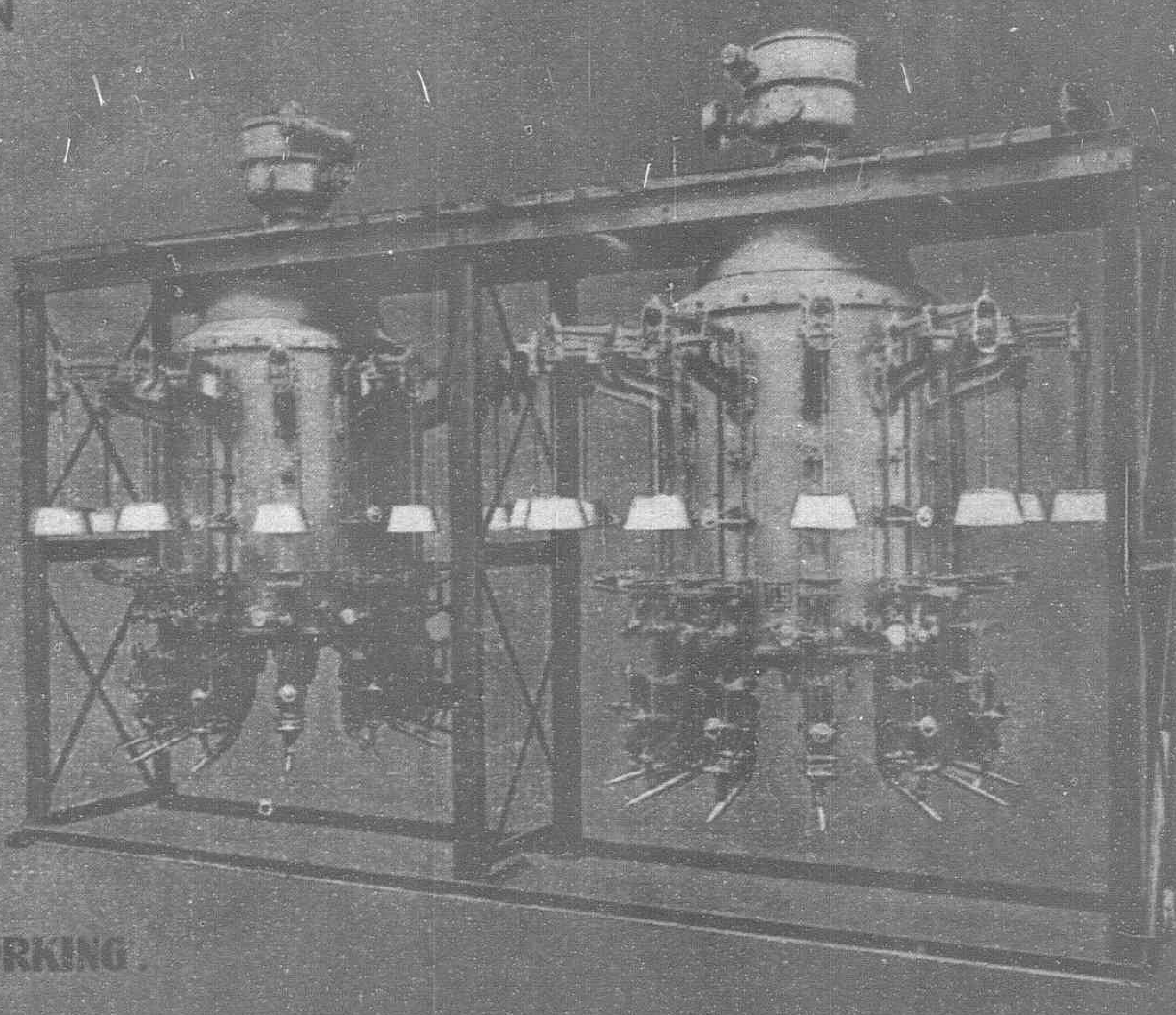

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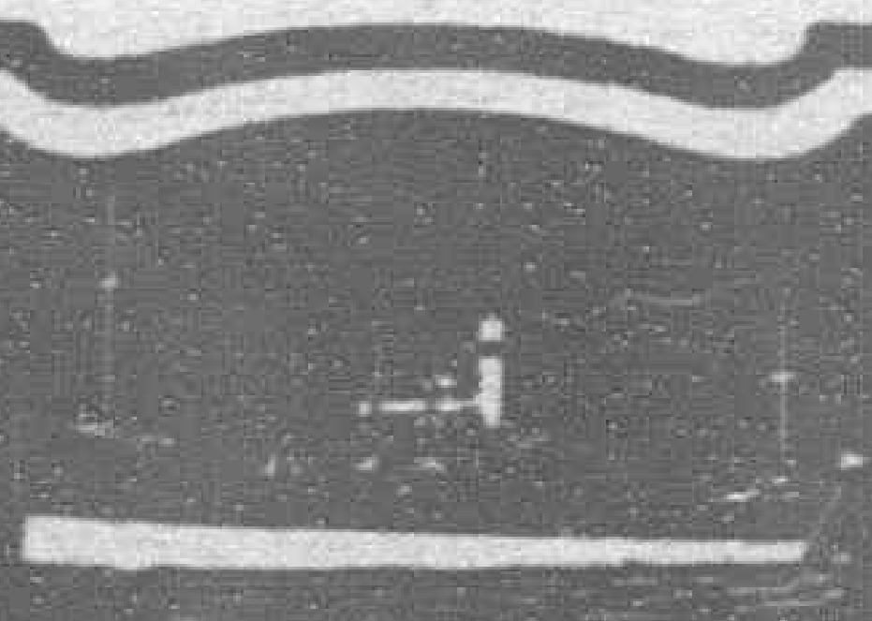

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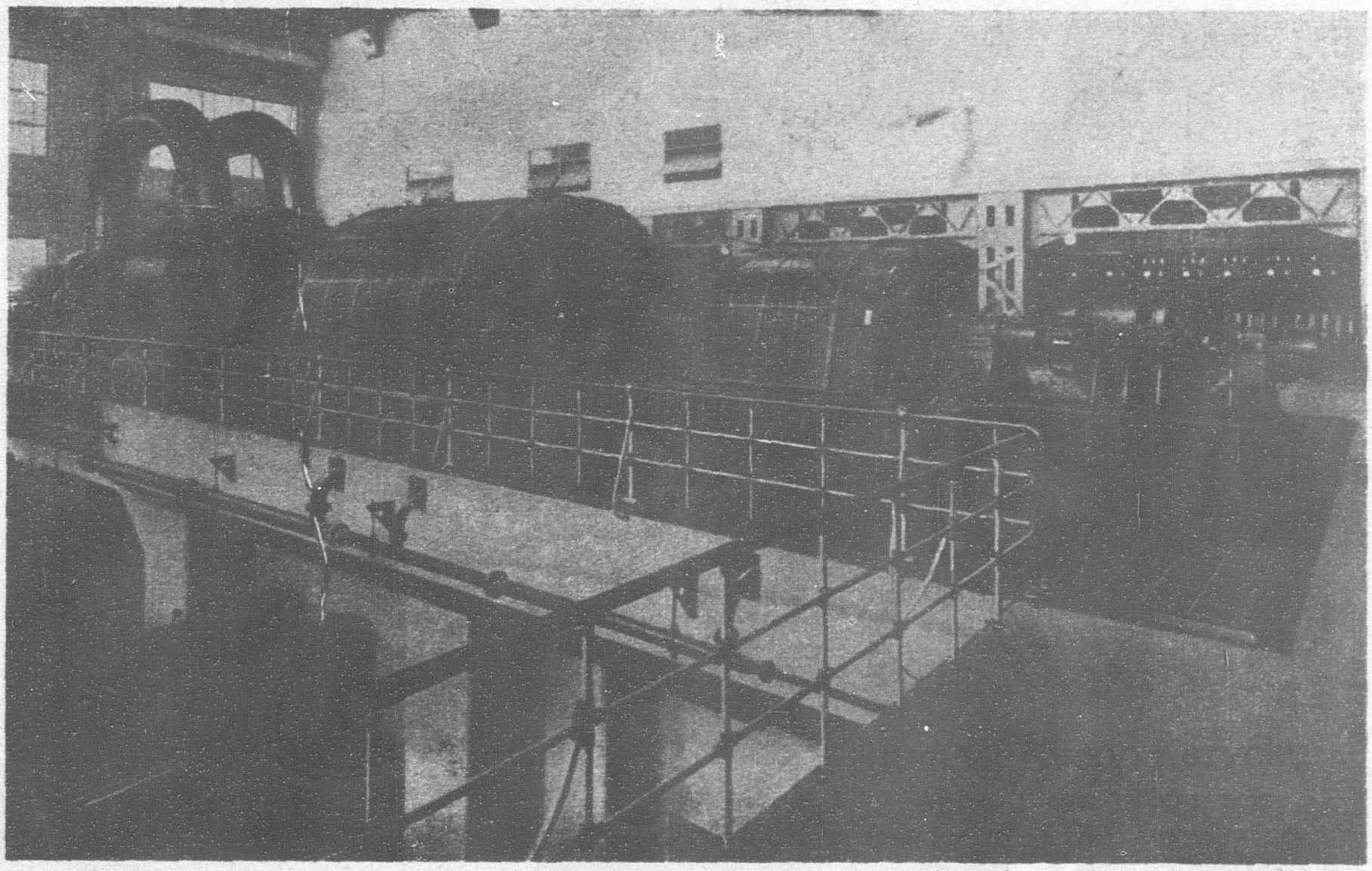

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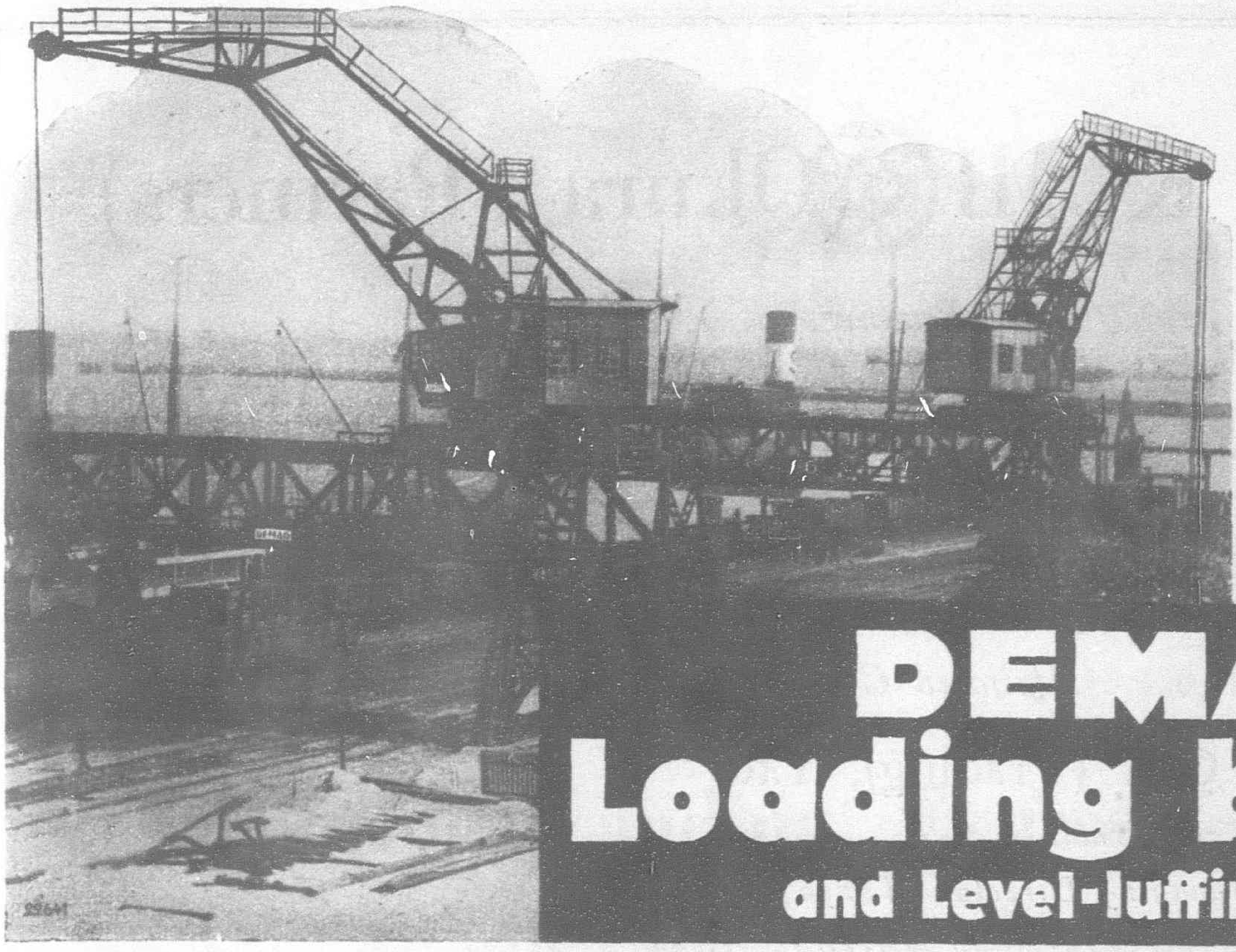

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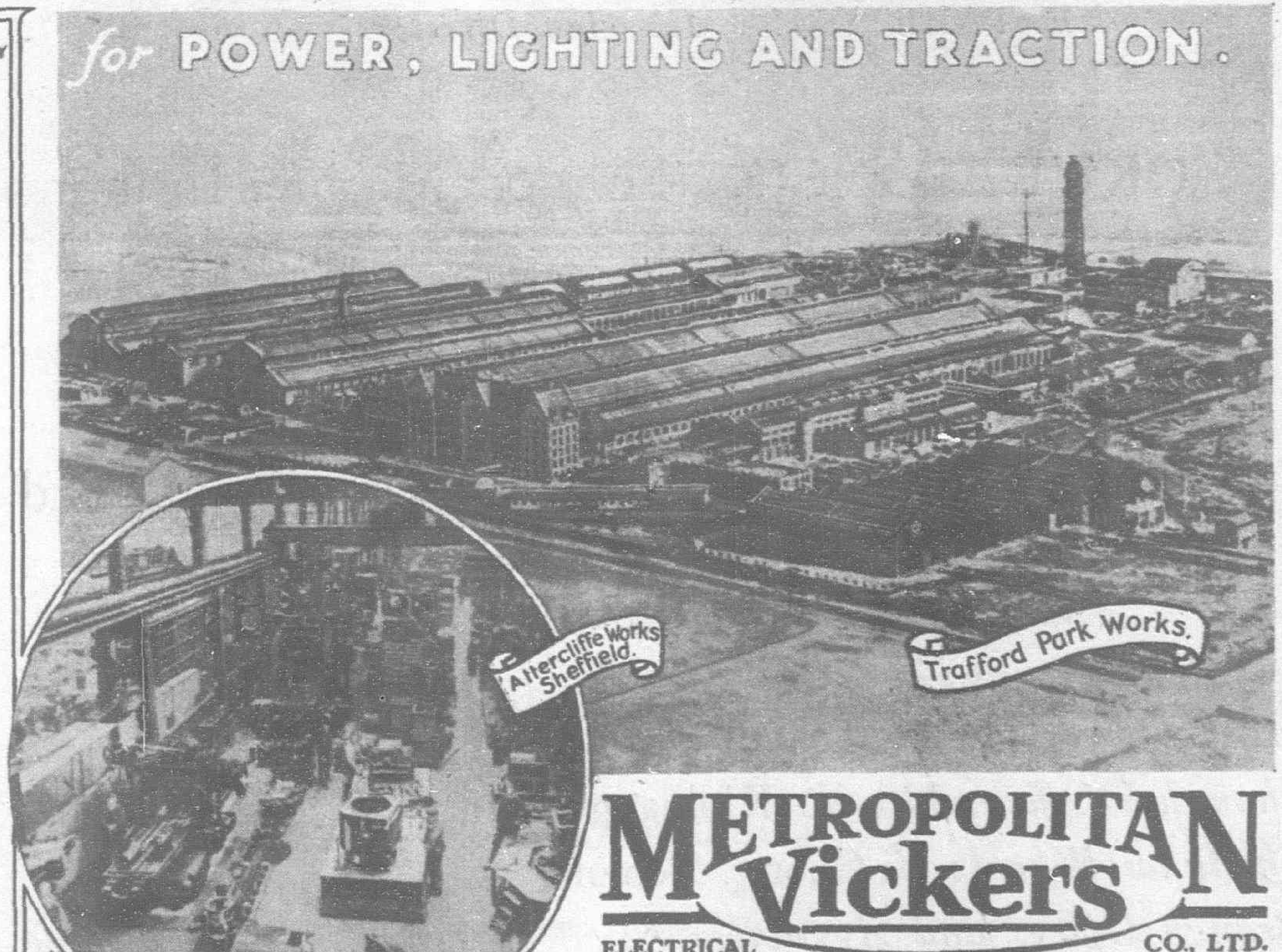

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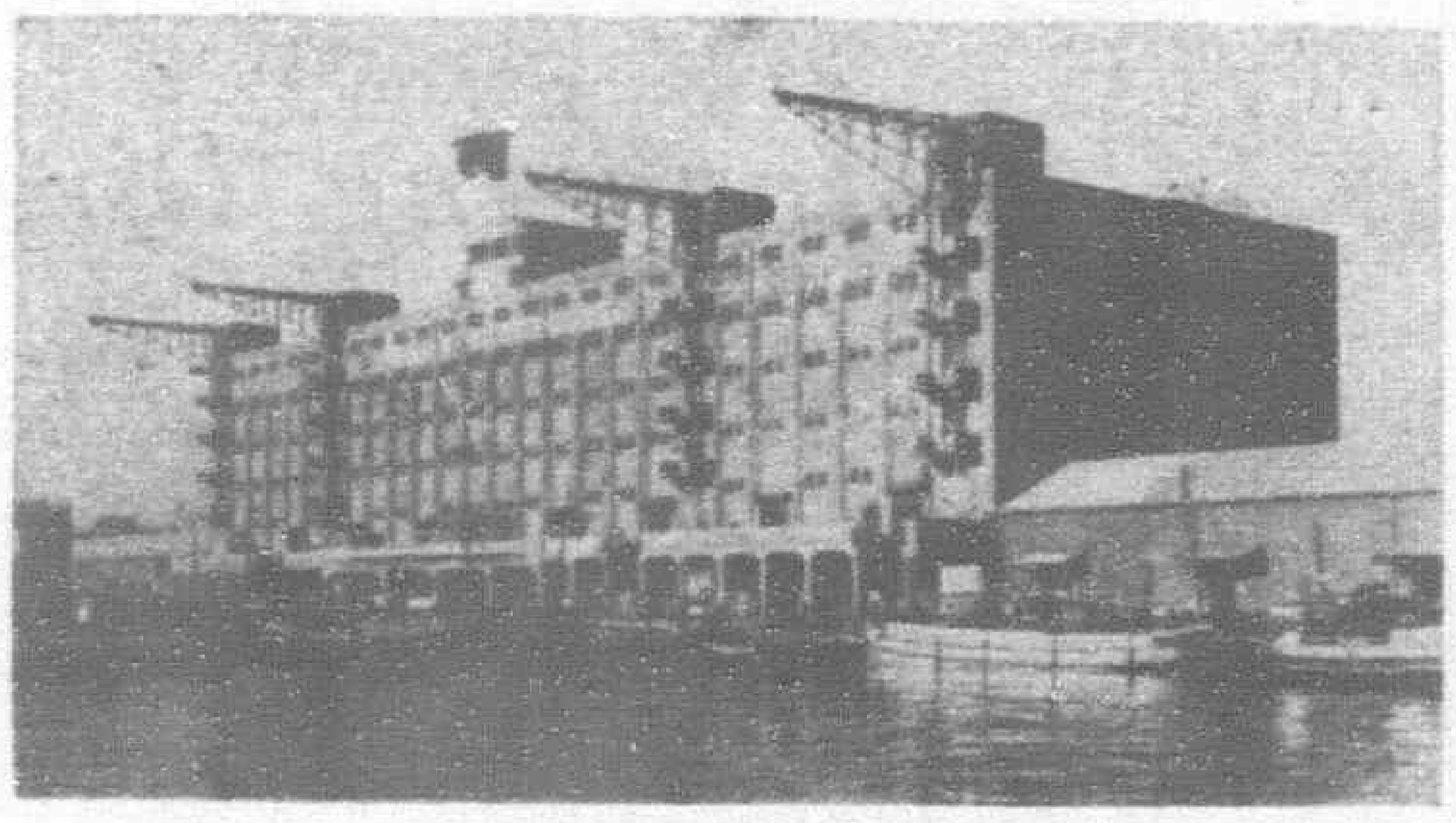

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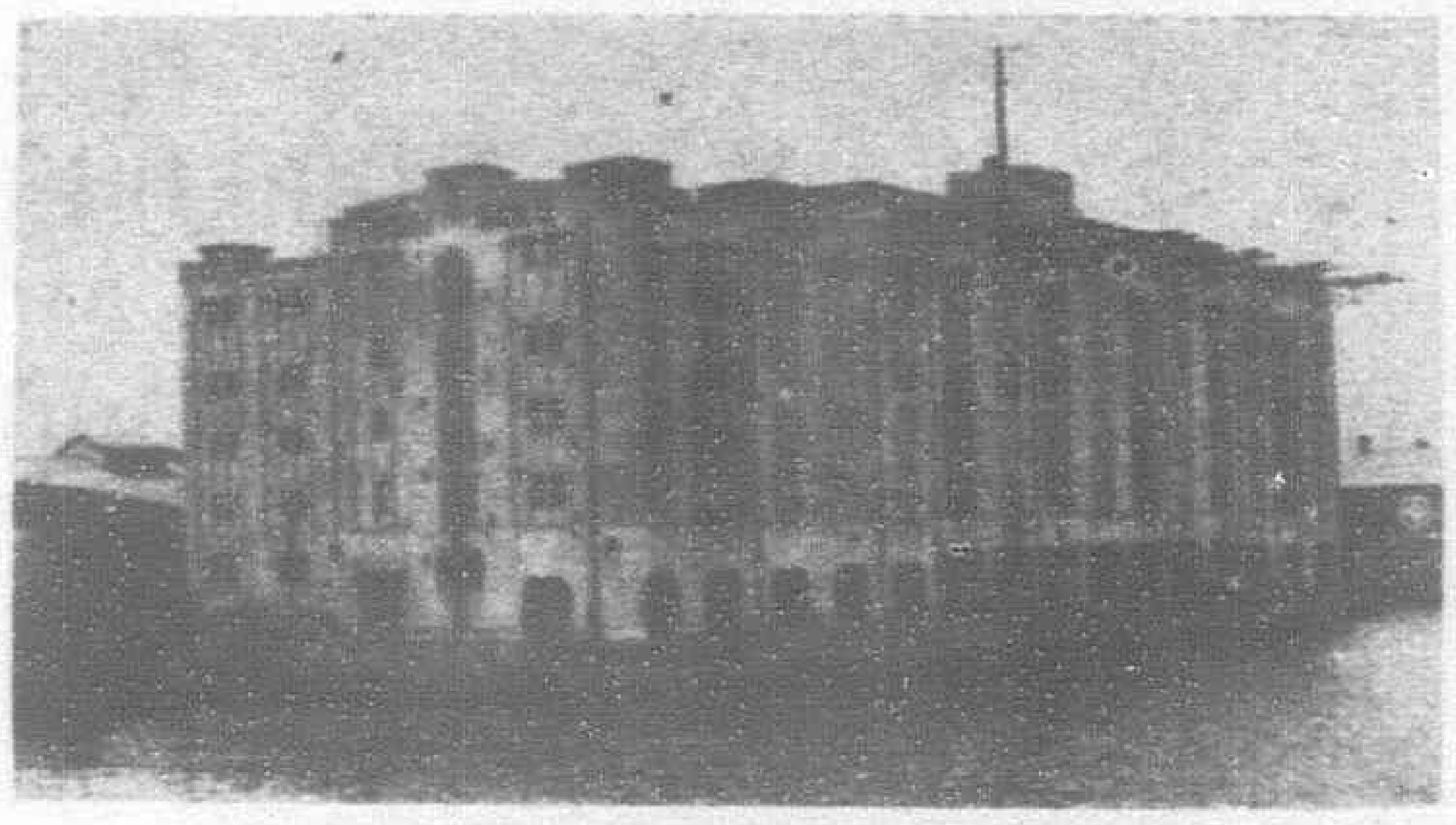

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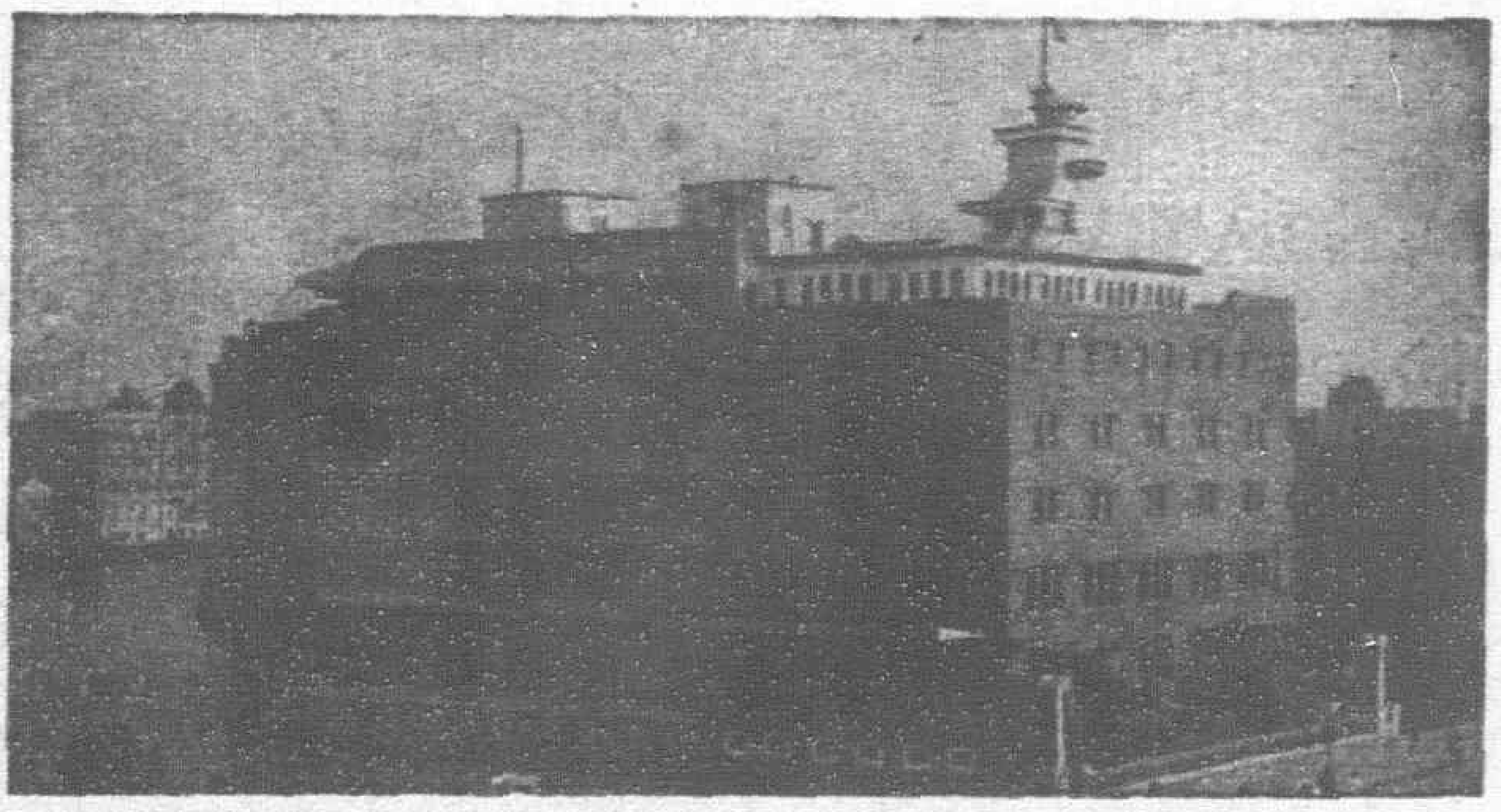

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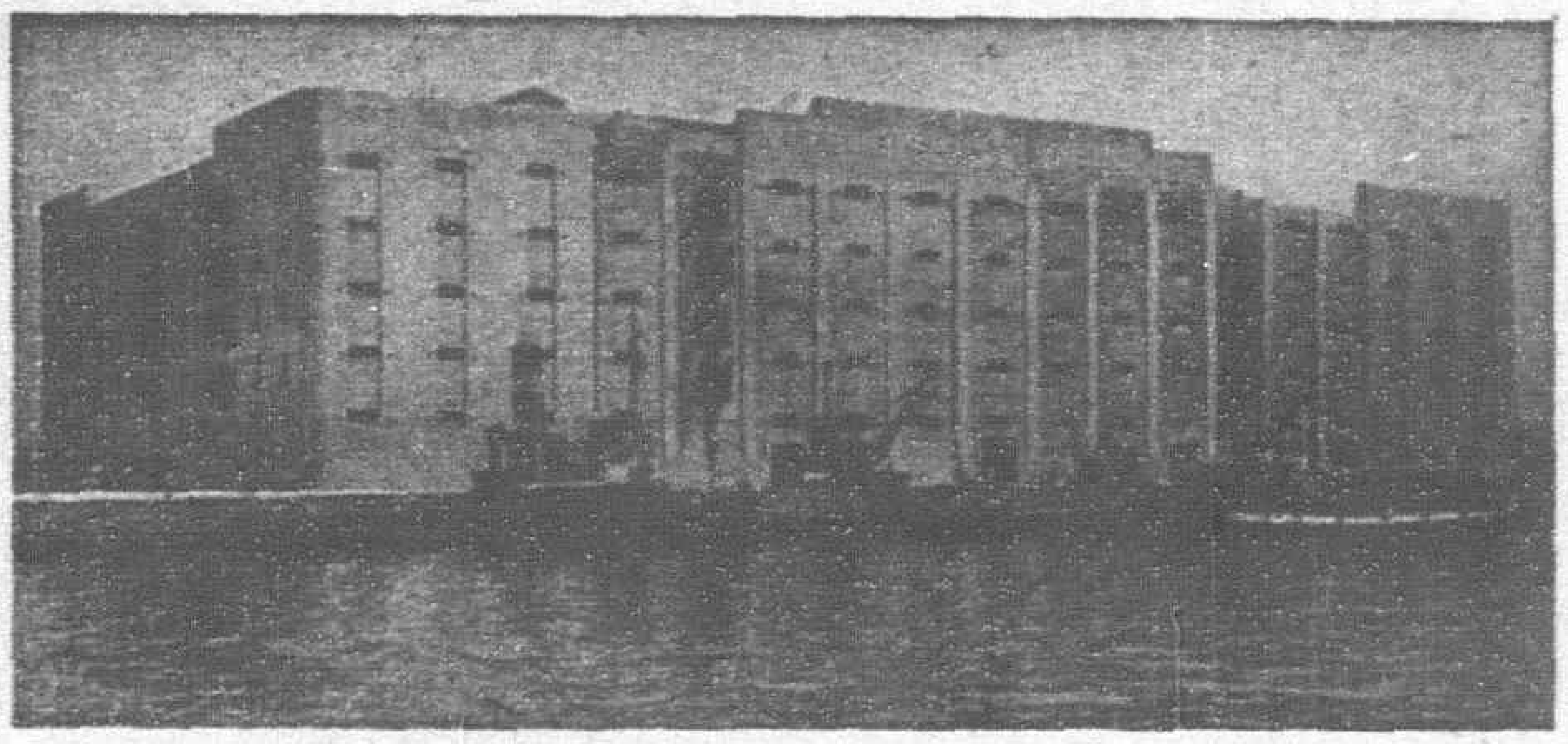

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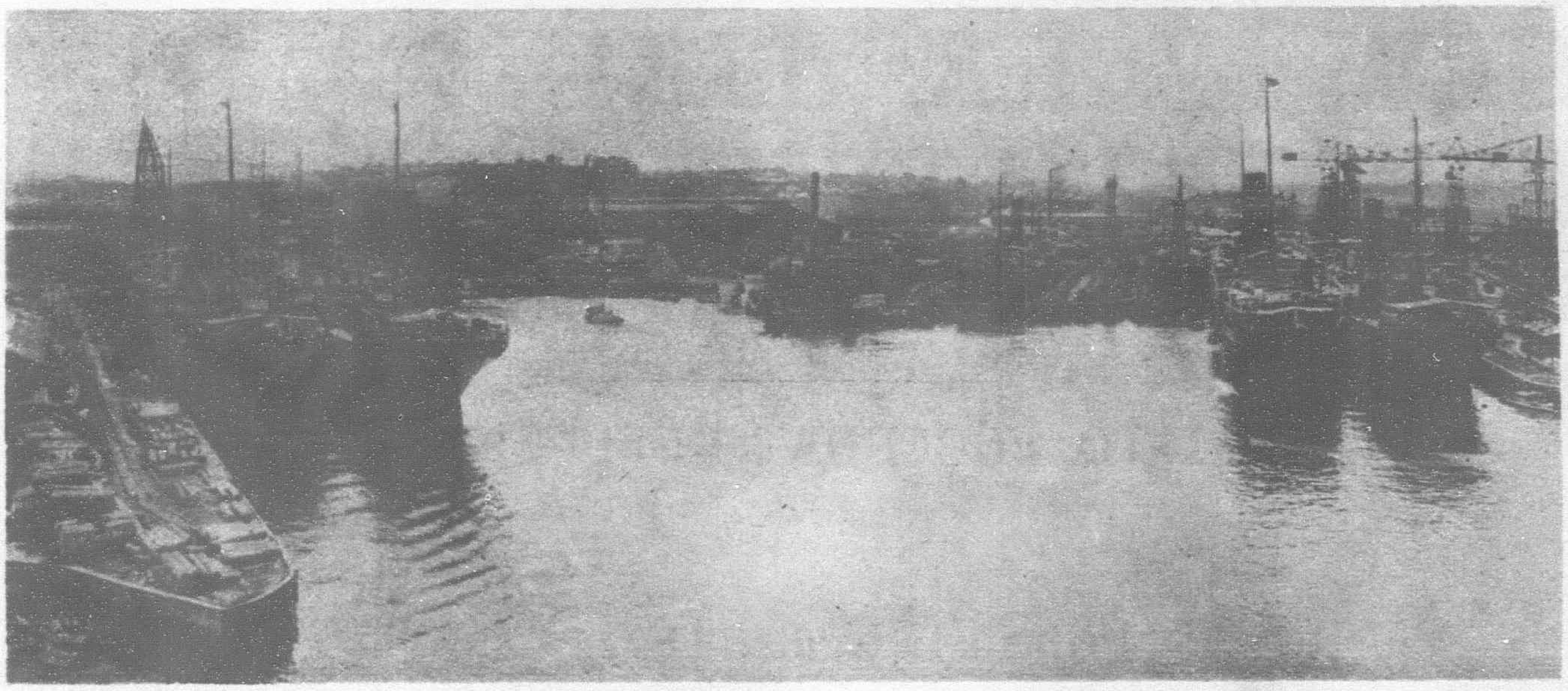

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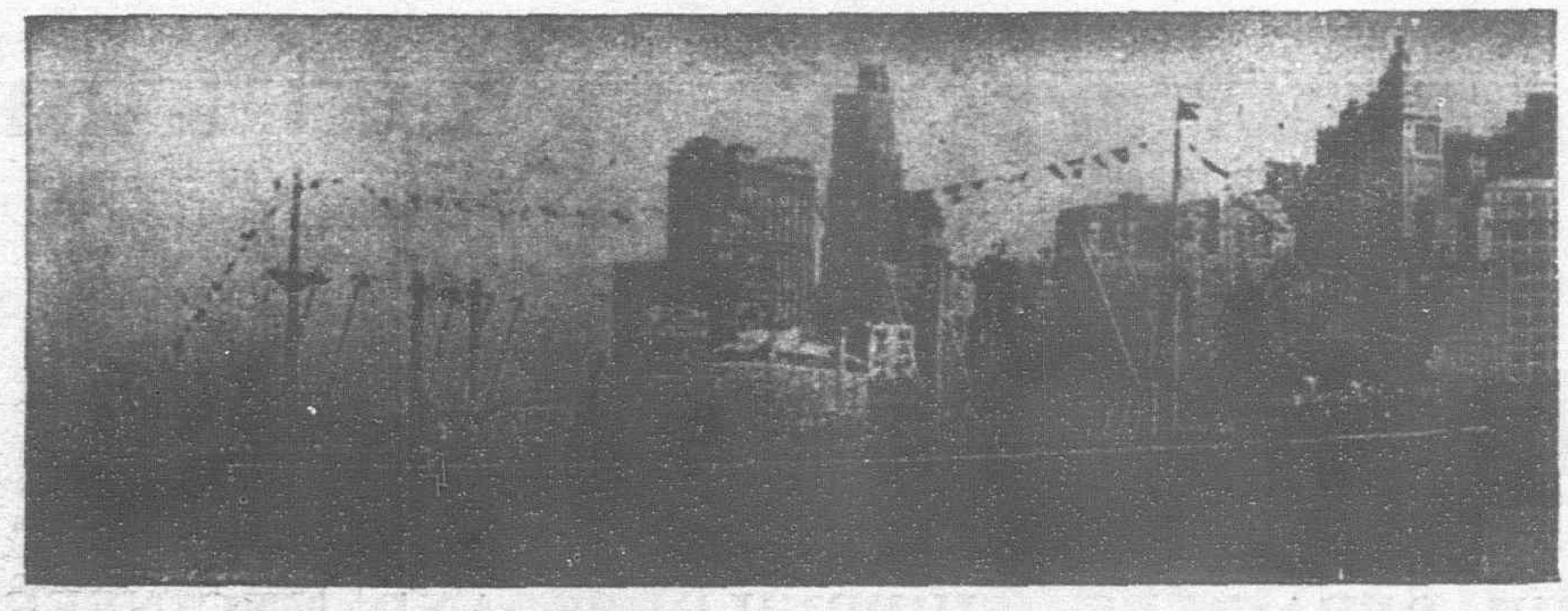

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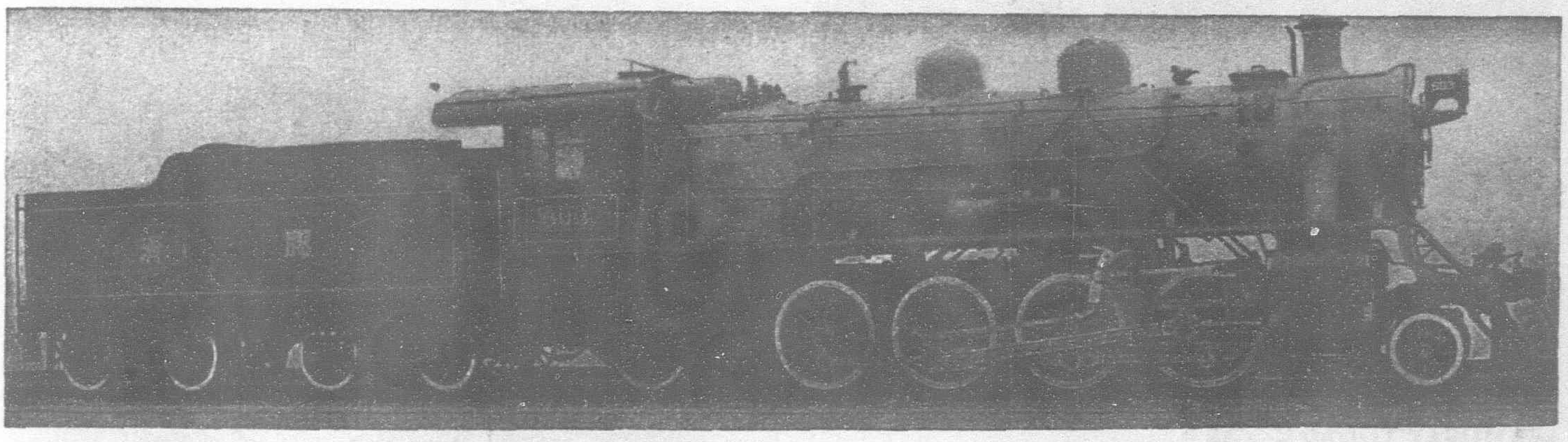
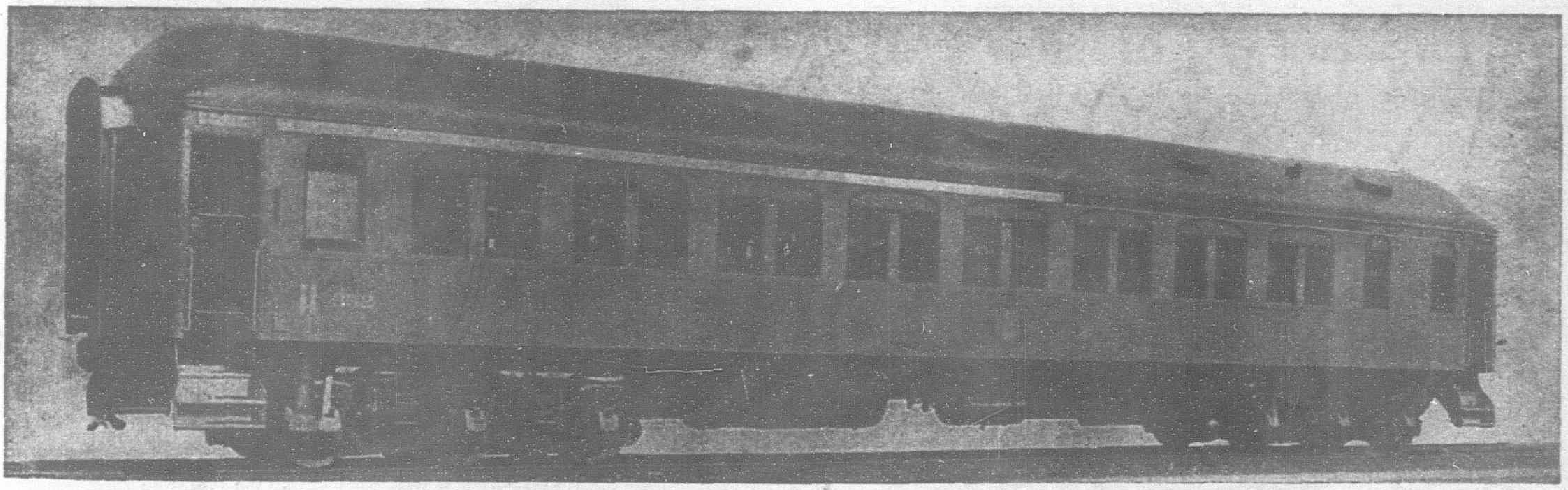


One of the Pacific Type Locomotives for the Chinese Government Kiaochow-Tsinan Railway built at the S.M.R. Workshops at Dairen



All Steel Passenger Coach built by the Railway Works for the S.M.R.

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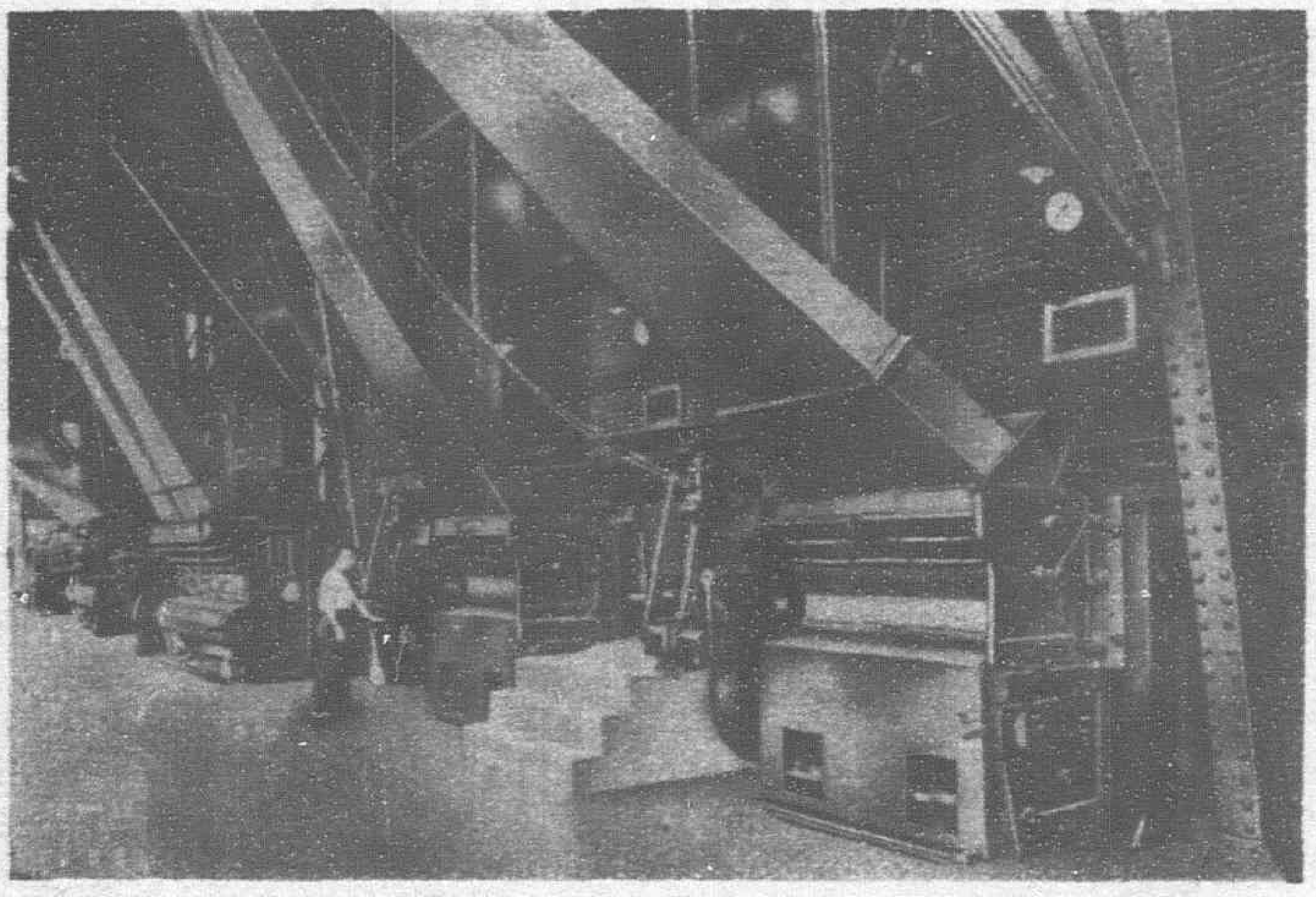

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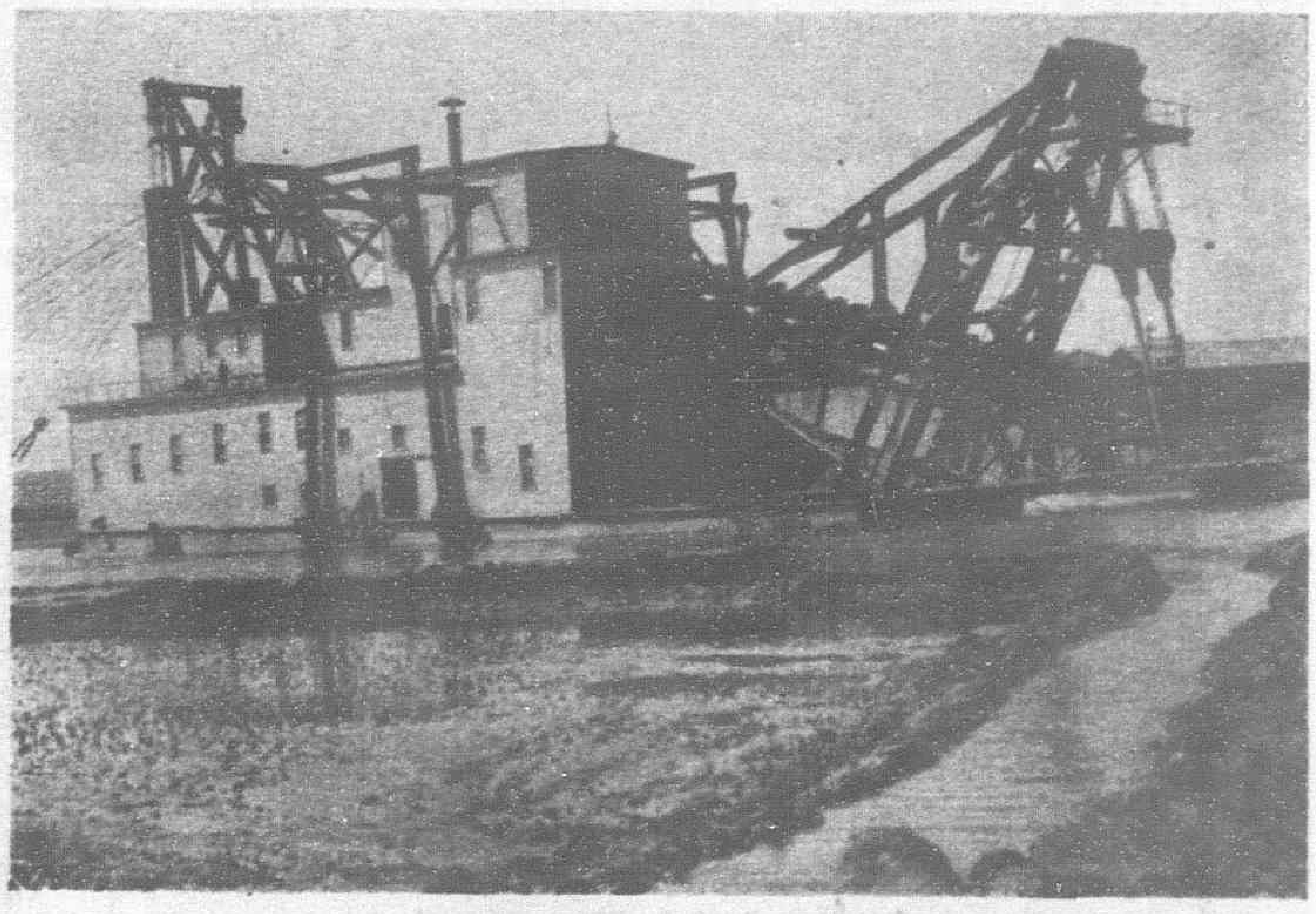

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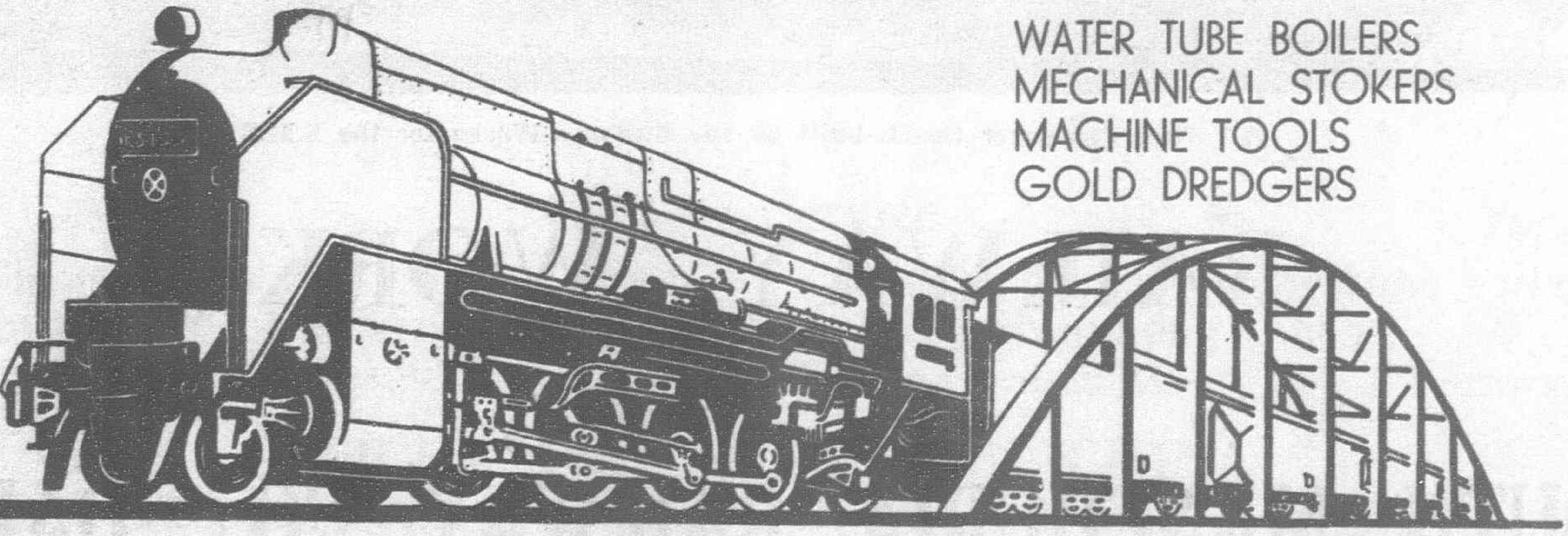

Capital Y. 150,000,000

Reserve Funds (March 1937):
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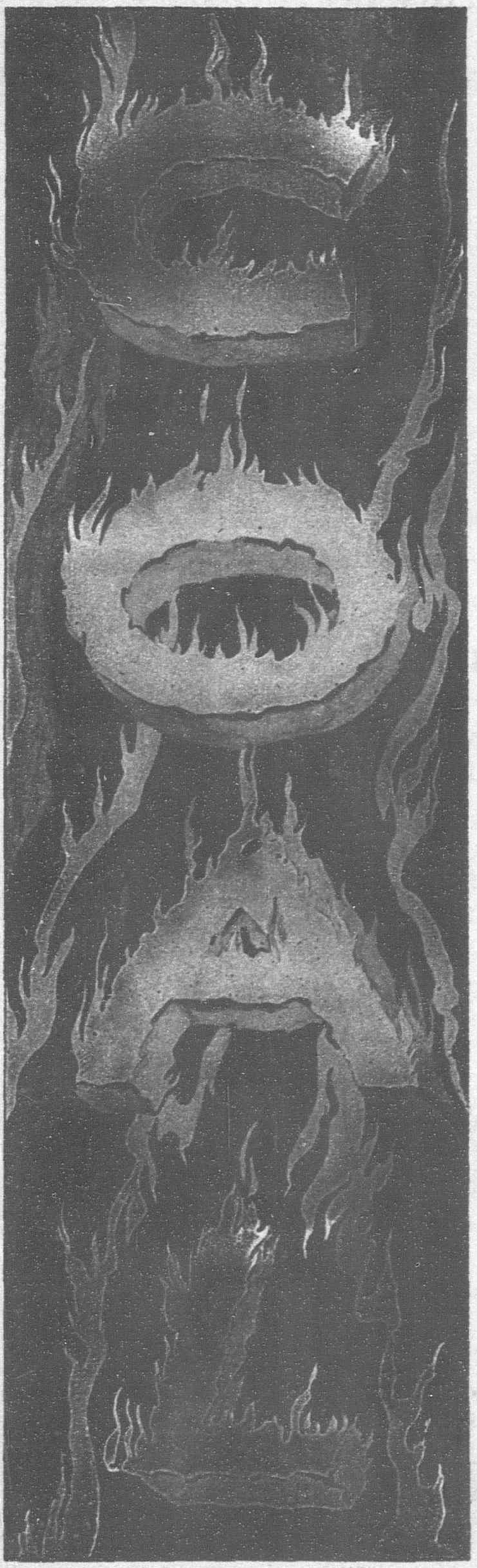

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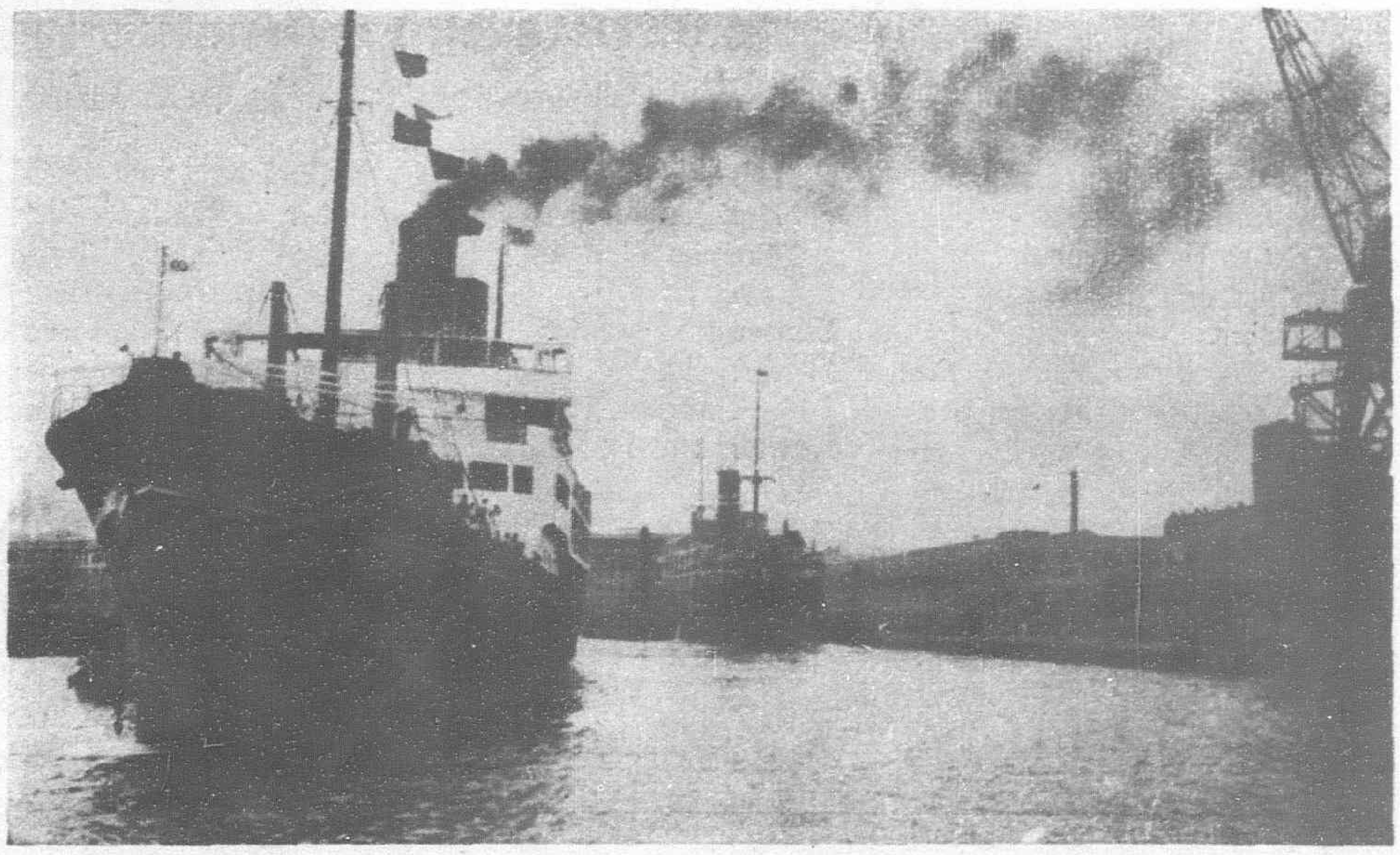

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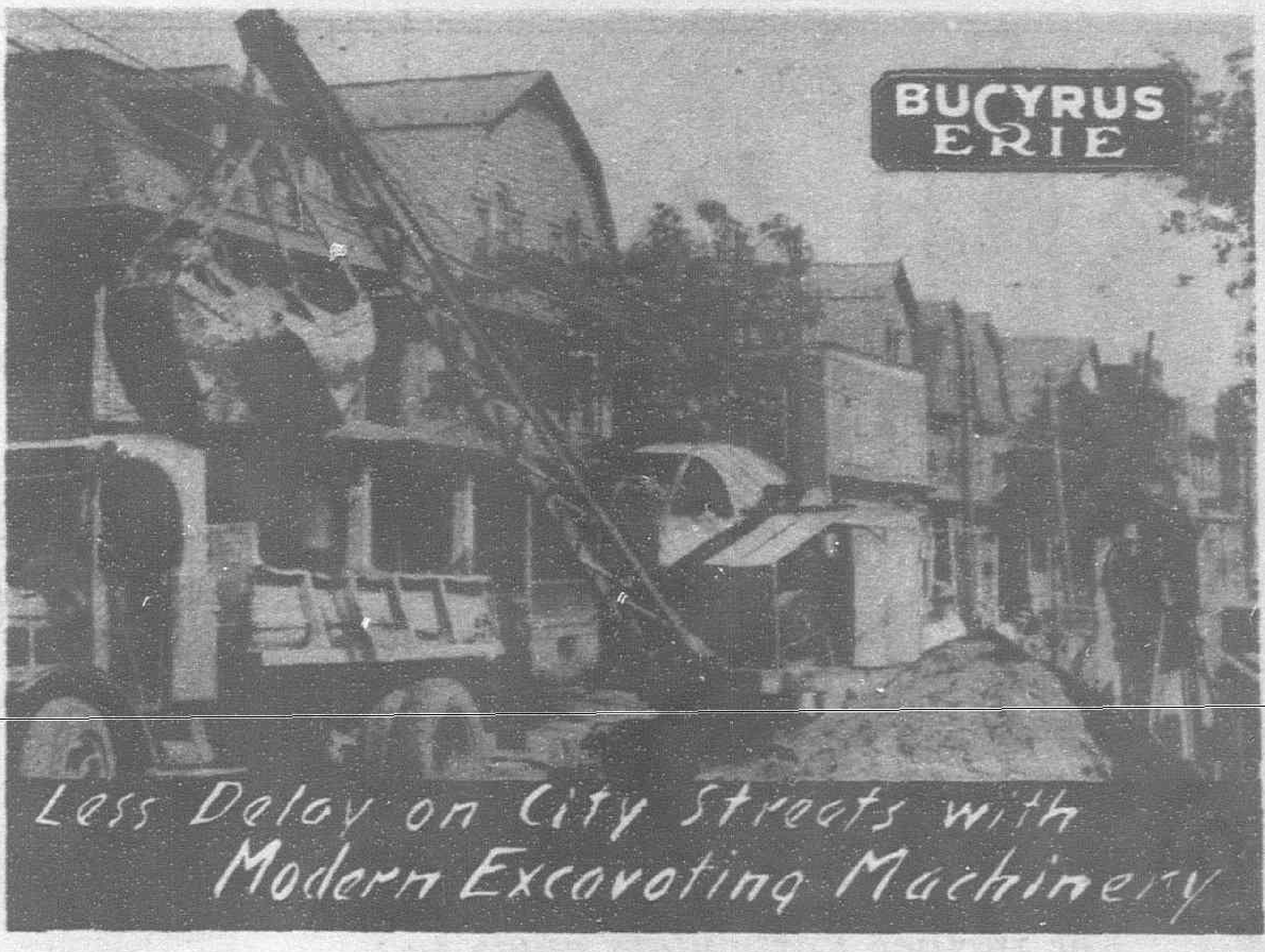

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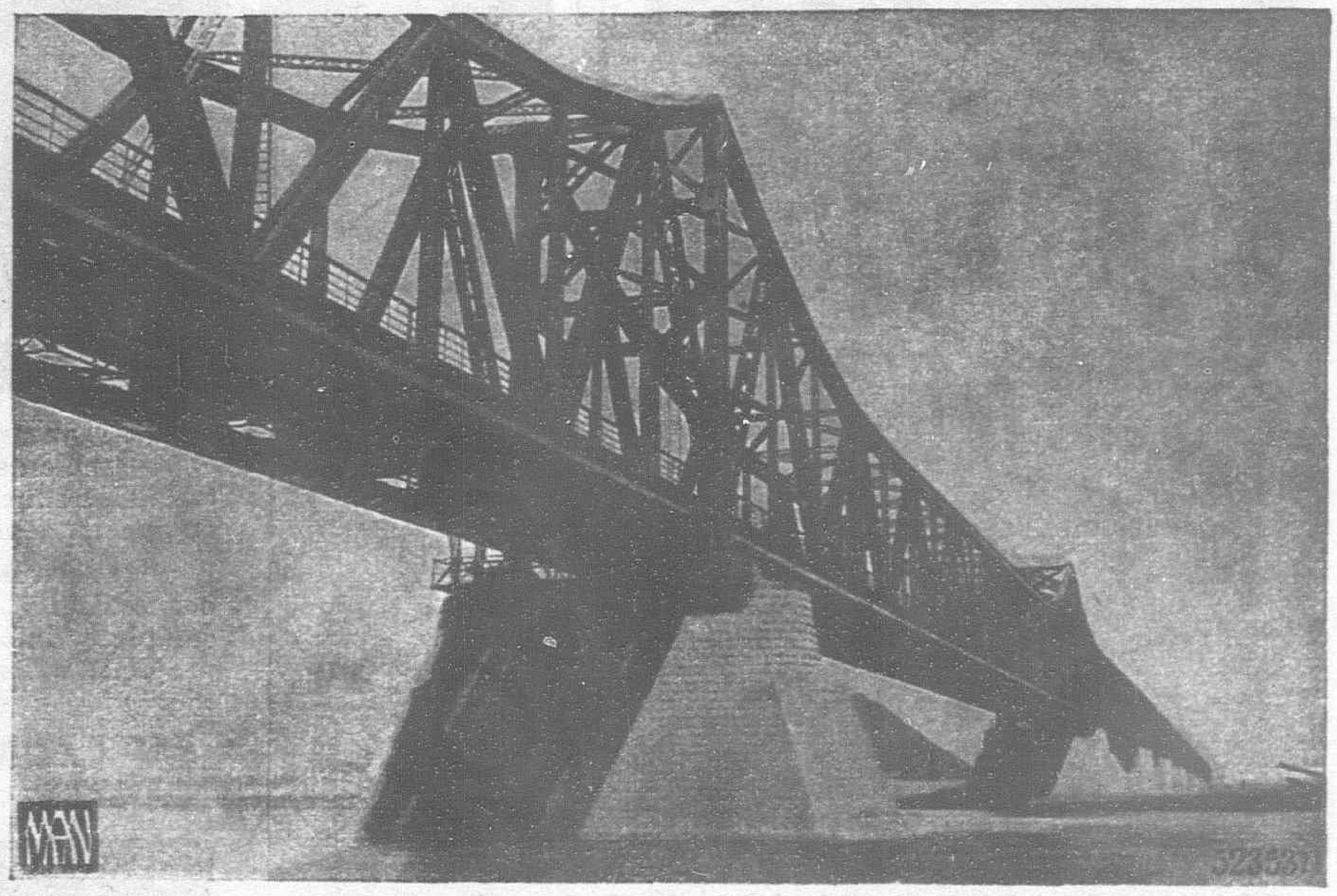

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Sterling Reserve Fund .. .. £ 6,500,000
Reserve Liability of Proprietors .. $20,000,000

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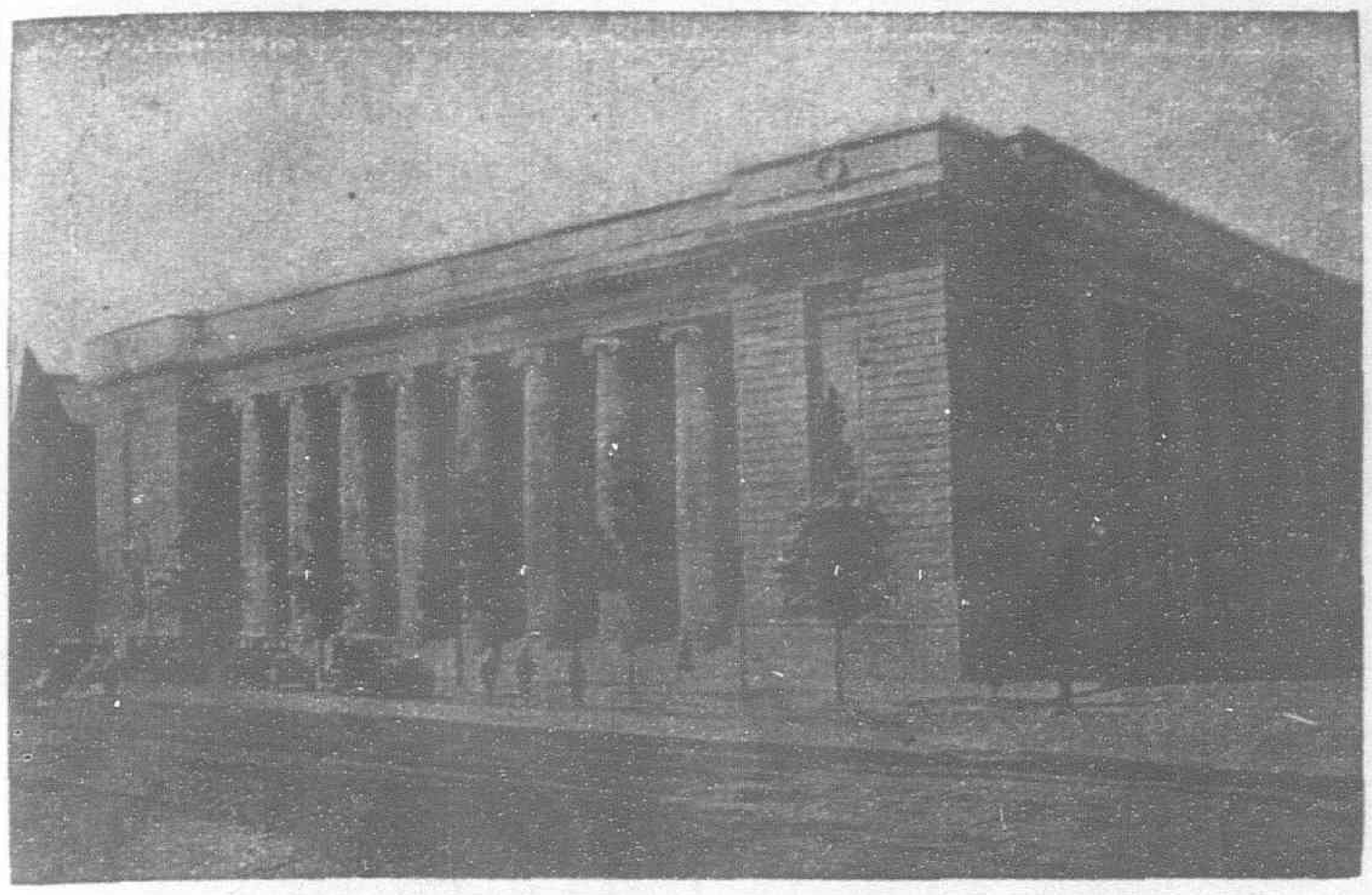

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CAPITAL PAID-UP - - Yen 62,500,000

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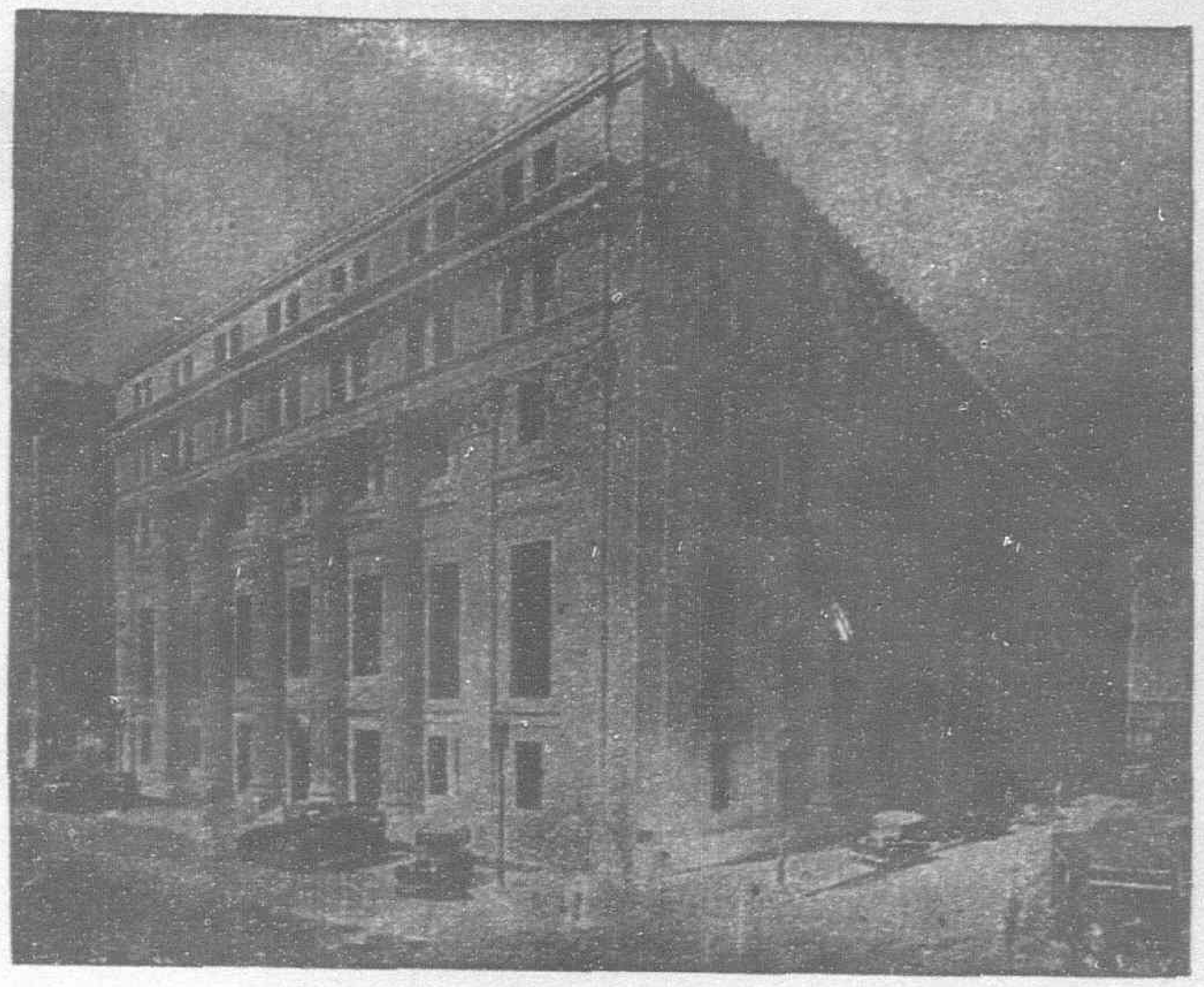

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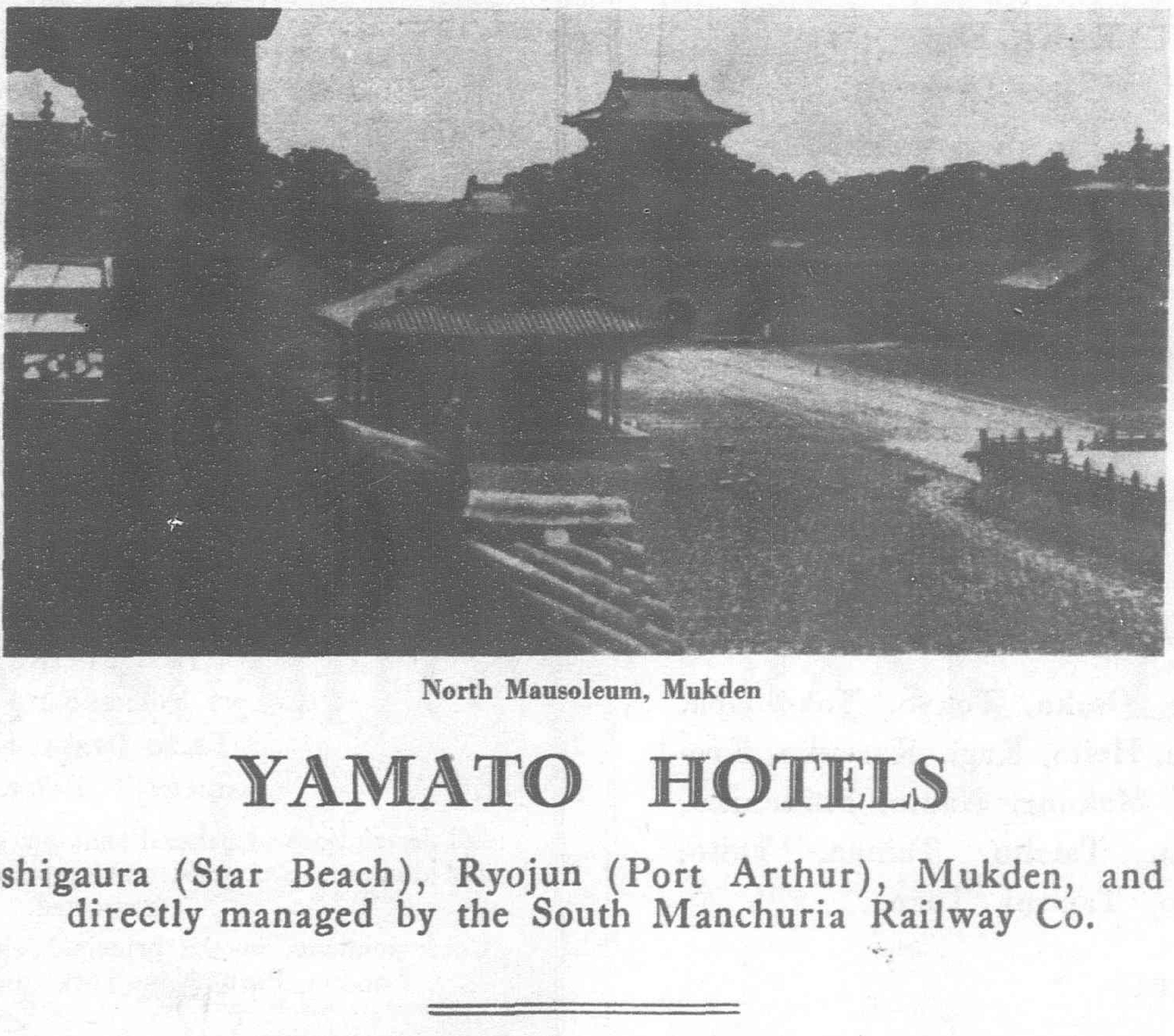

North Mausoleum, Mukden

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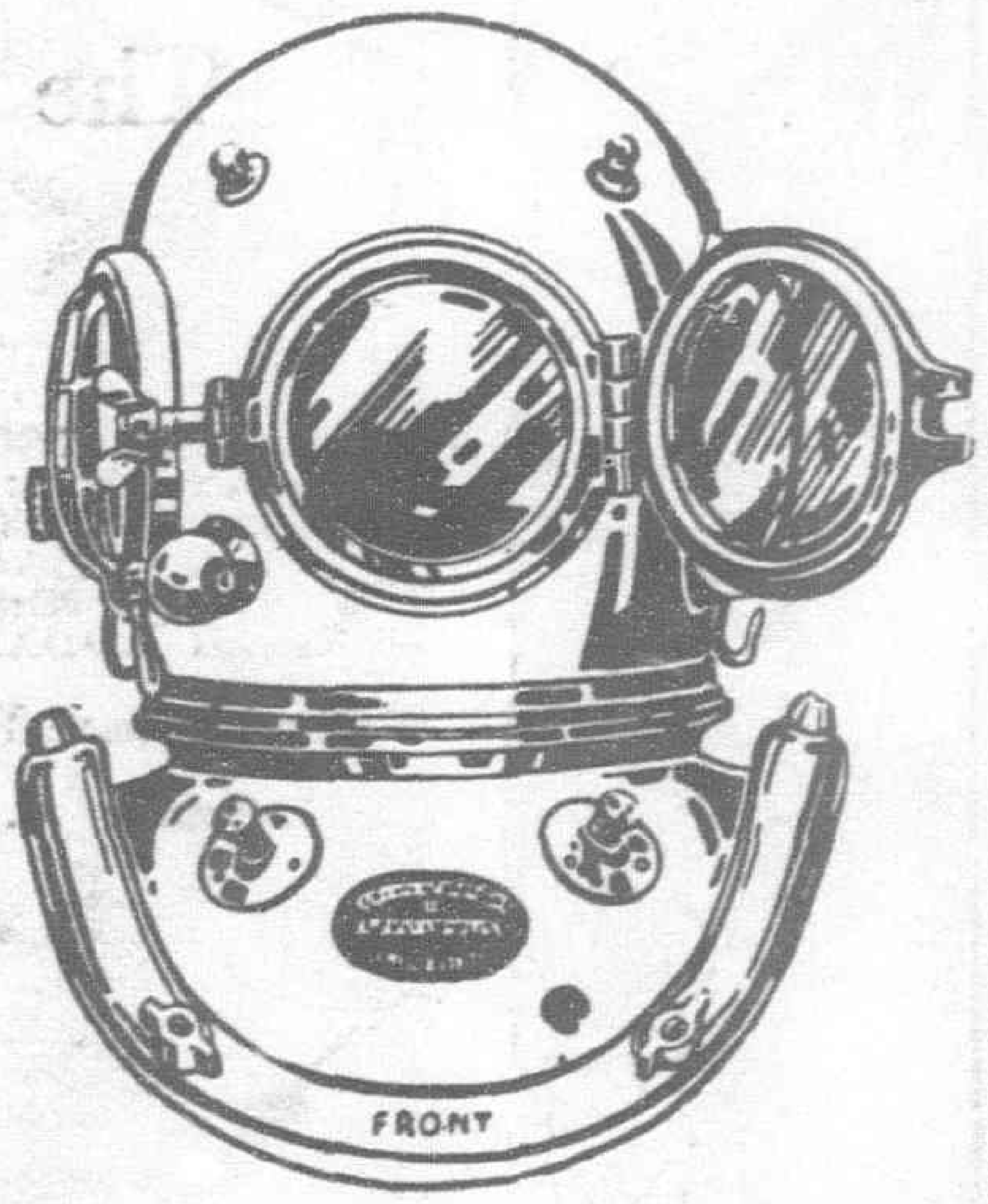

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Japan's Position in the Conflict

Of all the questions which are vibrating through the international firmament of discussion since the outbreak of the current Sino-Japanese conflict, the most pertinent remains to be that which relates to the driving forces which led Japan into action.

Stripped of all details the current China Incident can be said to represent the over-due clash between Japan's inevitable continental policy and China's national policy of anti-Japanism as an ill-conceived pretext for national unification. The firm grasp upon these two driving forces in the two countries concerned is essential for proper understanding of the issues at stake.

Since the Manchurian Incident, Japan has been directing her entire effort on the continent in assisting the growth and development of Manchoukuo and in re-establishing friendly relations with China. Meanwhile, she has been witnessing a growing rivalry among nations of the world, especially in Europe, and the consequent reappearance of a heated armament race. Most noteworthy to Japan has been an amazing expansion of the Soviet war machine which, on the one hand, forced Japan to join hands with Germany for mutual defence against Communism, and, on the other hand, increased Japan's concern in protecting her rights and interests in the Far East against Soviet threat. This concern naturally

MATSUOKA'S MESSAGE

On October 9, Mr. Yosuke Matsuoka, President of the South Manchuria Railway Company, released a message to the American public through the Associated Press in which he outlined Japan's mission in Asia. So impressive is the presentation of Japan's position by Mr. Matsuoka that its reproduction here is appropriate.

* * *

At last Nippon is in for the final, for a knock-out decision; a once-for-all house cleaning of all tortuous tangles in the Sino-Nippon relations which have been plaguing the East for ages.

In 1904, she staked her national existence in a fight against Russia. But that was to beat back a nightmare avalanche from without—an affair around outer fences.

This time, she is dealing with a festering sore deep down within the bosom of Eastern Asia threatening her very life as well as those of all Asian races with sure and inescapable death. It is calling for heroic surgery: She has taken up her scalpel. She will permit no foreign interference whatsoever here.

Plainly, therefore, the present crisis is infinitely bigger and more significant than the Russian war of thirty-three years ago.

One thing is clear even to a donkey running along an Asian highway:—a constant and hearty co-operation between the peoples of Nippon and of China, that and that alone can work out the destiny of Asia. Nobody knows this better than Nippon and she knows also that the two things poisoning the atmosphere between the two peoples are the drunken orgy of China's own war-lords and politicians and the Red Communism eating into the heart of China from without. Nippon is out to-day to put a potter-field wooden cross over these common enemies of the Chinese people and of the lasting peace of Eastern Asia.

Nippon has no quarrel whatever with the people of China. Our treatment of the Chinese who are living in Nippon to-day, is the most convincing comment on this point. In Hokkaido, in northern Nippon, a Chinese committed suicide rather than be compelled to return to his own native home, a little over a month ago. The Chinese in Nippon were happy and well protected, enjoying all the freedom of a Nippon citizen even while the infamous Tungchou massacre was all over the front pages of our newspapers.

A historic fact dominates Asian scenes like a Fuji: namely: Without Nippon there can be no China.

Suppose Nippon had chosen to play safe and crawled into her shell on her own tight little island in the fall of 1904?

Suppose again that Nippon had gone down before the tidal-wave sweep of Russian adventure for her own Far Eastern Empire on the plains of Manchuria in the spring of 1905?

There would have been no Manchuria, for which the Chinese patriots froth at the mouth or the League of Nations denounce Nippon as an international robber. And in place of the proud Republic of China, one would have had seen a crazy quilt of European colonies after the fond fancies of the author of the "Break-Up of China."

No Nippon: No China.

For some mystic reason our Chinese friends in Nanking find it so convenient to forget this little fact.

We are free to admit that Nippon has been exceedingly annoying to her neighbor, China. Nippon is expanding. And what country in its expansion era has ever failed to be trying to its neighbors? Ask the American Indian or the Mexican how excruciatingly trying the young United States used to be once upon a time.

But Nippon's expansion, like that of the United States, is as natural as the growth of a child. Only one thing stops a child from growing: death.

Geneva has been trying to pass this death sentence on Nippon since the Manchurian incident, masking it with tinsel phrases of pious hypocrisy. But Nippon does not seem amiable enough to die even for the sweet sake of Geneva-made peace.

China and Nippon are two brothers who have inherited a great mansion called Eastern Asia. Adversity sent them both down to the depth of poverty. The ne'er-do-well elder brother turned a dope fiend and a rogue, but the younger, lean, but rugged and ambitious, ever dreamed of bringing back past glories to the old House. He sold newspapers at a street corner and worked hard to support the house. The elder flim-flammed the younger out of his meager savings and sold him out to their common enemy. The younger in a towering rage beat up the elder—trying to beat into him some sense of shame and awaken some pride in the noble traditions of the great house. After many scraps, the younger finally made up his mind to stage a showdown fight. And that is the fight now raging.

"Nippon is fighting for loot and profit!" That is the refrain of all anti-Nippon propaganda the world over. It is an insult to plain arithmetic. Nippon has already spent billions of yen in the present crisis. The Imperial Diet a couple of weeks ago voted for more than two billion yen just to tide over a few months. The final total may reach fifty billions or more: who knows? Can a financial optimist anywhere conceive of Nippon getting back even two, three billion yen a year from China? And that amount would be a meager annual interest charges on the Nippon outlay for this present crisis. Absurd even to a primary school arithmetic class, all this fight-for-loot theory.

For what, then, is Nippon fighting?

She is fighting simply for her conception of her Mission in Asia. There is the whole answer.

She is fighting to keep Asia from becoming another Africa and, in particular, at the present moment, to save China from the death grip of Comintern. Just that.

Billions of yen, thousands of her young men's lives—all are offerings on the altar of her own conviction and aspirations. She is simply footing the bill which the leadership of Asian races calls for. No treasure trove is in her eyes—only sacrifices upon sacrifices. No one realizes this more than she does. But the very life of her own depends on it as those of her neighbors as well.

The all-absorbing question before Nippon to-day, therefore is: CAN SHE BEAR THE CROSS?

involved, in view of Japan's vast interests in Manchoukuo, the assurance of peace and order in North China as well as the security of Japan's rights and interests in the whole of China. In the face of this situation, however, China has deliberately singled out Japan in pursuing a decidedly hostile policy during recent years and has been slighting Japan's friendly overtures for peaceful negotiations with discourtesy and contempt.

It is obvious that Japan is much concerned over North China. It adjoins Manchoukuo geographically, and the people of North China and Manchoukuo, as neighbors, are most intimately tied to each other in communication and finance, and in the constant interchange of goods. Should the movements directed against Japan and Manchoukuo be tolerated there and become rampant, it is not necessary to stretch one's imagination very far to visualize that peace and order in Manchoukuo would be gravely menaced. Moreover, Japan's rights and interests in North China are closely related to the development and utilization of resources such as iron, coal and cotton, but hostile movements there would jeopardize those rights which are vital to Japan, especially in view of growing international unrest. Under these circumstances, it was only natural that Japan began to look at the affairs in North China with increasing concern. It was in the face of such a situation that the Nanking Government intensified anti-Japanism as a means of rallying the people in the interest of national unification and of expanding its own power thereby. In line with this policy, the Nanking Government made a demand on Japan to give up her rights and interests in North China already described.

An Artificial Reaction

In this picture, one must not overlook both the peculiar nature and the true significance of the anti-Japanese movements in China. For, anti-Japanism in China in recent years, while it may be said to reflect in a way the popular national consciousness nurtured by the general spirit of patriotism and anti-foreignism, is neither a spontaneous expression of the people's patriotic spirit nor an insatiable desire of the Chinese people in general. In other words, it is something which has been forced upon the people by the Nanking authorities.

The Nanking Government is a peculiar existence. Its authority is maintained, not through its indisputable strength and ability to govern the whole of China, but through an ingenious manipulation and combination of one-party bureaucracy, compradorism, and military dictatorship. Naturally, the only effective means available in keeping the centralized political power at Nanking is to camouflage its weakness which has found a ready slogan in " Kang-jih Chiu-kuo " or " Resist Japan and Save China," backed by China's age-old policy of " Yuan-chiao Chin-kung " or " Befriending Distant States and Antagonizing Neighbors " and the utilization of Western Powers.

Such being the background of the anti-Japanese movements in China, the Kuomintang leaders were faced with profound dilemma at the time of the outbreak of the current conflict. Indeed, men like Wang Chao-ming, Ho Ying-chin, H. H. Kung, T. W. Sung, and above all Generalissimo Chiang Kai-shek knew too well the comparative strength of the Japanese and Chinese armies and China's doomed defeat if she dared oppose Japan with arms. It is for this reason that outwardly they pretended to assume a strong stand but inwardly were hoping to avoid a general clash with Japan if it could be avoided at all.

It was at this juncture that a new force entered Nanking circles and began to manipulate public opinion. It was the pro-Soviet force, represented by such strong leaders like Feng Yu-hsiang, Sun Fo, and Li Lieh-chun. They were quite aware of Chiang's weakness and planned to embarrass him by insisting upon the adoption of a strong anti-Japanese policy. Behind them stood, of course, the crafty figure of the Comintern with its ulterior motive of communizing China.

The anti-Japanese movements, launched to strengthen the Chiang dictatorship at Nanking, however, were already beyond Chiang's control. Its propaganda contaminated even the school children and bred among young officers of Chiang's own army a blind confidence to fight Japan. In short, the Nanking leaders have been playing with Japanese patience too long and have awakened to discover that it is next to impossible to repair a broken egg. And thus the curtain was raised upon the tragic drama of an armed conflict. It may be added here with emphasis that the wide-awake Generalissimo did not forget to strengthen his own political power in planning the campaign and wisely manœuvred to annihilate his provincial enemies, especially the armies of Yen Hsi-shan, Han Fu-chu, Li Sung-jen, and Pai Chung-hsi, by mobilizing and sending them to the first line of fighting. This was indeed a " two-birds-with-one-stone " policy but, alas, the war-lords knew too well Chiang's deceiving manipulations.

Such was the internecine but ingenious hand of the Comintern which successfully forced the Compradore Government at Nanking to shift from the capitalistic influence of the Powers to the control of the Red Popular Front. Such also was the masterly China policy of the Soviet Union. And thus China and Soviet Russia began to walk hand in hand as far as the anti-Japanese movements in China were concerned.

A Memorable Manifesto

The Chinese Communist Party had been tirelessly working toward this end for some time. By 1935, its machinations were so successful that it issued on August 1, a memorable manifesto under the title of " Anti-Imperialism of the Chinese Communist Party and Anti-Japanese National Salvation." It openly advocated in this manifesto a policy of co-operation with the Nanking Government and of widening the popular front for immediate anti-Japanese resistance. From that date on, it intensified its efforts, on the one hand, in trying to nourish Chiang's anti-Japanese strength by arousing racial hatred among the masses and, on the other hand, in planning for an inevitable collision between Tokyo and Nanking as it knew too well that there would be a limit to Japan's patience under constant provocations. Behind this delicate manœuvre, needless to add, was the Soviet Far Eastern policy of both solidifying the Soviet position in China and attaining realization of its own military program by bringing about the weakening of Japan's Soviet policy through a Sino-Japanese clash. The Sian *coup d'état* staged by Chang Hsueh-liang was merely an episode in this masterly Comintern manœuvre. In the dramatic negotiations which followed to save the Generalissimo, while the British part was undeniably noticeable, the fact remains that Chou Ssu-lai, the chief " brain " of the Chinese Communist Party, was active in bridging the group represented by Chang Hsueh-liang and Yang Hu-cheng and the Nanking Government, thus clearly demonstrating the Red initiative involved in the affair. It was on account of such a clear-cut background that the Japanese Government, in spite of its extreme patience and determined desire for peaceful negotiations, found it impossible to reach a solution, not even a compromise of any kind.

When the North China Incident finally broke out, the Nanking Government unhesitatingly liberated seven imprisoned leaders of the Chinese Communist Party, including Shen Chun-ju, Wang Tsao-shih, Shih Liang, and Chang Nai-chi, transformed the Communist armies under the command of Chu-Te and Mao Tse-tung into a wing of the anti-Japanese units, and concluded a non-aggression treaty with Soviet Russia on August 21. China was thus placed under the complete domination of the Soviet Union.

The Russian Treaty

Foreign Commissar Litvinoff denied the existence of any Sino-Soviet secret agreement but the *Kokutsu* (Manchoukuo News Agency) on September 24, reported from Shanghai the seriousness with which the Nanking Government was studying the draft treaty of Sino-Soviet mutual assistance. The draft treaty is reported to be as follows :

(1) China and the Soviet Union will establish a joint defence committee against Japan, with headquarters at Ulanbator, Outer Mongolia.

(2) Nanking and Moscow will co-operate in every way to attain as fully as possible these objectives :

- (*a*) International trouble will be created in either Europe or the Far East in order to render useless the Japan-Germany Anti-Comintern Agreement.
- (*b*) The two countries will strive to scatter as much as possible the Japanese forces, through action on the Soviet-Manchoukuo border, the Manchoukuo-Outer Mongolian border, and the North, Central and South China fronts.
- (*c*) The Comintern will work to disturb thought in Japan.

(*d*) Guided by the Comintern, guerilla fighting will be taken up to undermine the Japanese military operations.

(*e*) To attain these objectives, the Soviets will take charge of operations in North China and along the Manchoukuo borders. Central and South China, with Shanghai as the center, will be under Chinese control.

(3) The Soviet Union will supply China with volunteer soldiers and technical advisers, as well as arms and ammunition in case of need. This will be done on the following lines.

(*a*) China will deposit half of what it owes the Soviet Union in the State Bank of the U.S.S.R. to pay for the arms and ammunition it receives.

(*b*) China will pay fixed sums to the soldiers and technical advisers supplied by the Soviets. The Soviet Union shall insure their lives in the "gosstrah" (Soviet State Insurance Bureau).

(*c*) The first installment of munitions will be delivered to the Chinese between the end of September and the first of December. It will be transported via Outer Mongolia and Sinkiang.

(*d*) The first shipments will consist of 362 airplanes of various types; 100 anti-aircraft guns; 200 pieces of field artillery; 120,000 rounds of cannon balls; 150,000 rifles; 60,000,000 rounds of ammunition; 100 tanks; 1,500 anti-aircraft machine-guns; 2,500 motor-cars and cycles; 5,000 horses and 2,000 carts.

(4) In exchange for Soviet assistance, China will promise to carry out the following undertakings:

(*a*) The Comintern is to be permitted full freedom of activity in China.

(*b*) China will grant to Moscow full freedom of political and economic activity in Outer Mongolia and in any consequences.

(*c*) Nanking gives Moscow the right to build a railway connecting Outer Mongolia, Sinkiang and China Proper. China will later make other concessions in North China.*

(*d*) If and when the anti-Japanese move ends in success, China promises to drive out, with Soviet assistance, all other foreign political influences now active in China.

It was through such circumstances that the Nanking policy of opposing and oppressing all Japanese activities in China underwent a complete change in tactics, from the reliance upon and manipulation of Western Powers to the more malignant and ferocious anti-Japanism under the Red influence. The Red influence, in fact, has deliberately sacrificed China before the mischievous god of anti-Japanism and signs of transforming her into a second Spain are already in evidence.

Japan's Demands Upon China

In facing the current China Incident, Japan's most fundamental demand upon China is a just understanding by the Chinese people of the inevitability of Japan's continental policy.

It is a well known maxim of physics that a force seeking expansion, when suppressed all around, will inevitably break out at the weakest point of resistance. Fundamentally, Japan's continental policy has been similarly propelled, not by any luxurious aspirations for additional territory, but by an inevitable social necessity. It cannot, and must not, be compared, therefore, with the conquest of extensive colonies staged by the leading Western Powers in the not distant past. By deliberately ignoring the true significance of the Japanese policy and branding it simply as militaristic or imperialistic, China is merely courting disaster.

Consider for a moment, then, Japan's inevitable necessity of expansion. Her population is increasing at the rate of about one million a year. This expanding power can be mitigated only by emigration abroad and increase of exports. Unfortunately for Japan, however, both of these roads are closed against her. And, under the present international setting, China is the only country toward which Japan's expansion can be directed naturally. Such being the case, China is Japan's inevitable life line and any attempt to check Japan therefrom is a physical impossibility.

Yet, Japan is not asking China to recognize this physical inevitability unconditionally. Japan has historical basis in asking China for co-operation in facing such a physical inevitability.

It is not necessary to recount here what China's international position was at the time of the Sino-Japanese War or the Russo-Japanese War and through the two decades leading to the emergence of Manchoukuo. Any one who is familiar with the history of the Far East since the closing decade of the last century cannot overlook the telling fact that, not only has China been completely impotent in preventing the inroad of Western imperialism, but she has shown no capacity to contribute anything toward the maintenance of peace in the Far East. Rather, she has been the cause of disturbances, in one way or another, through the past fifty years. Indeed, where is the country, if Japan is excepted, which can whole-heartedly maintain stability in the Orient and which is willing to pay even the greatest of sacrifices in the name of its prosperity? Where would China be if it weren't for Japan? And yet, China proposes to deny all such historical facts. She proposes to ignore, in line with the same policy, the very fact that it is the result of Japan's historical advocacy which has assumed concrete form in the establishment of Manchoukuo and the North China agreements in her defence. Thus, the "Tangku Agreement" of May, 1933, and the "Umezu-Ho Agreement" of May, 1935, both concluded between Japan and China as an aftermath of the Manchurian Incident, have been trampled one after another under China's feet on account of her erroneous conception of Japan and her self-styled over-confidence. How can Japan, after paying more than her share of sacrifices in the name of peace in the Far East during the past fifty years, remain unconcerned with such an attitude of mind?

In the second place, Japan, for the purpose of promoting mutual development, advocates the necessity of both attaining intimate political and cultural relationship and strengthening the mutual economic tie between the two neighbors. Japan has been playing an important rôle in the economic development of China in the past and is destined to do so in the future. Take for example Japan's contributions in the field of China's foreign trade. As the following tables† show, Japan has occupied a leading position, second only to the United States, in her trade relationship with China since 1934:

CHINA'S FOREIGN TRADE, 1934-36

(1) *Imports (Unit: 1,000,000 Chinese dollars)*

Countries	*1934*		*1935*		*1936*	
	Amount	*Percentage*	*Amount*	*Percentage*	*Amount*	*Percentage*
U.S.A.	271.7	26.2	174.9	18.9	185.5	19.6
Japan	126.8	12.2	139.6	15.1	153.5	16.3
Germany	93.4	9.0	103.4	11.2	150.2	15.9
England	124.6	12.0	98.2	10.6	110.5	11.7
Total	616.5	59.4	516.1	55.8	599.7	63.5
Grand total (including others).	1,038.9		924.7		944.5	

(2) *Exports (Unit: 1,000,000 Chinese dollars)*

Countries	*1934*		*1935*		*1936*	
	Amount	*Per centage*	*Amount*	*Percentage*	*Amount*	*Percentage*
U.S.A.	94.4	17.6	136.4	23.7	186.3	26.4
Japan	81.2	15.2	82.0	14.2	102.3	14.5
Germany	19.1	3.6	28.9	5.0	39.1	5.5
England	49.8	9.3	49.4	8.6	64.8	9.2
Total	244.5	45.7	296.7	51.5	392.5	55.6
Grand total (including others).	535.7		576.3		706.8	

In the amount of investment in China, Japan occupies a similar dominating position, this time second only to that of England. According to investigations made by Prof. C. F. Remer, the leading

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*A report in *The North-China Daily News* of January 16, 1938, says:—A railway linking China with Russia will be constructed to facilitate the transportation of arms and ammunition from Europe to China, according to an unconfirmed Chinese report published by a Chinese paper. The railway, to be financed by Soviet Russia, will run from Chungking via Chengtu, Sungpan, Tsinghai and Sinkiang province to Soviet Russia, according to the report. All building materials, it is reported, will be supplied by Russia, and the cost will constitute a credit or loan. The same report says this loan will be secured on the railway property and receipts and will bear interest of four per cent per annum, to be calculated after the conclusion of the present hostilities. Repayment of principal will begin five years after the war, and to be completed over a period of twenty years, it is reported. The engineer in charge of the construction will be a Soviet Russian and will draw no salary from the Chinese Government. The new railway is estimated to be 4,000 kilometers long and about 8,000,000 Chinese laborers will be employed so that the line may be completed in a short time, according to the report.

†Figures from the Chinese Customs Reports.

foreign investments in China, including government loans, at the end of 1931 were distributed as follows (in 1,000,000 U.S. dollars):

Countries	*Investments*	*Government Loans*	*Percentage*
England	1,189.2	225.8	36.7
Japan	1,136.9	224.1	35.1
U.S.S.R.	273.2	—	8.4
U.S.A.	196.8	41.7	6.1
France	192.4	97.4	5.9
Germany	87.0	12.0	2.7
Belgium	89.0	48.0	2.7
The Netherlands	28.7	18.7	0.9
Italy	46.4	42.0	1.4
Total (including others) .	3,242.5	710.6	100.00

If we consider the significance of investments in China in their relations with the investing country, however, the importance of Japanese investments in China is found to be beyond comparison with those of England. Again, according to Professor Remer, the percentage of investments of various Powers in China with respect to total investments abroad is as follows: England, 5.9 per cent; U.S.A., 1.2 per cent; France, 4.8 per cent; Germany, 4.3 per cent; and Japan, 81.9 per cent. These figures eloquently show that Japan's investments abroad are almost entirely concentrated in China, whereas the major investments of other leading Powers are allocated elsewhere, other than in China. Herein lies the additional meaning of Japan's claim that China is Japan's life line. The most intimate character as well as the mutuality of the economic relations between Japan and China thus shown, in spite of Nanking sponsored anti-Japanese movements and boycott of Japanese goods, is and should be the most important factor in deciding the future course of Sino-Japanese relations.

Japan only desires that China clearly understand such intimate relationship between the two countries, strengthen the concert of action with Japan as the stabilizing force in the Orient, and co-operate fully for the establishment of permanent peace in the Far East. For this purpose, the Nanking Government must first of all liquidate its contradictory policy of using anti-Japanese movements as a means of mitigating the frictions arising between China and international vested interests. It must also purge China of all intrigues which are carried on by the Red Popular Front under the guise of anti-Japanese movements.

Japan's Economic Strength

JAPAN'S every hope to localize the Lukowkiao incident was frustrated by the Chinese and the field of Sino-Japanese conflict gradually expanded over a wide area. To meet this growing need, the Japanese Government obtained the sanction of the Imperial Diet for a total appropriation to date of Y.2,540,000,000, Y.520,000,000 by the Special (71st) Session and Y.2,020,000,000 by the Extra (72nd) Session, and announced its willingness to meet additional expenses in case of prolongation of the conflict. Compared with Y.200,000,000 expended in the Sino-Japanese War and Y.1,450,000,000 in the Russo-Japanese War, the total appropriations to date indicate both the tremendous development of Japan's economic strength since those two Wars and the degree of her determination in facing the current China Incident.

The financial position of the Japanese Government is admittedly none too bright. The public debt already exceeds Y.10,000,000,000 and now an enormous military expenditure of Y.2,540,000,000 is added with every prospect for additional emergency expenditures. Whether Japan can bear such a heavy financial burden at this time or not, is the question which is uppermost in the mind of many a critic, both in Japan and abroad. All the more, the Chinese propagandists have not missed the opportunity of spreading pessimistic views on the subject. The whole question is vital enough to demand serious inquiry.

That modern warfare consumes enormous expenditure has been conclusively shown by the late World War. Following are the appalling figures for the six leading countries in that War:

England	7,463,769,000 sterling
France	148,289,544,000 francs
Italy	41,852,000,000 lires
Russia	54,098,500,000 roubles
Germany	139,342,342,000 marks
Austria	84,434,000,000 kronen

These gigantic military expenditures are met by the general mobilization of the economic strength of respective nations and depend upon people's savings, people's income, and national wealth. Naturally there is a limit to the capacity to meet any large-scale military expenditures and, when such a limit is passed, the living power of the people is destroyed, social insecurity is precipitated by the shortage of commodities, and the continuation of war is made impossible. Thus, in order to conduct war effectively for a long period, it becomes absolutely necessary that efforts to stabilize the living conditions of the people should accompany the appropriation of military expenditures. In other words, military expenditures which will not destroy the living conditions of the people constitute the maximum capacity of the war-time national financial strength which is at the same time the maximum economic capacity to execute war. What then is the maximum capacity? The late World War has shown us the following results:

(1) PERCENTAGE OF WAR EXPENDITURES IN RELATION TO NATIONAL WEALTH

Countries	*National Wealth*	*War Expenditures*	*Percentage*
England ..	16,000,000,000 sterling	7,463,769,000 sterling	46.6%
France	256,500,000,000 francs	148,289,544,000 francs	57.7%
Italy	100,000,000,000 lires	41,852,000,000 lires	41.8%
Russia	120,000,000,000 roubles	54,098,500,000 roubles	45.0%
Germany ..	310,000,000,000 marks	139,342,342,000 marks	44.9%
Austria	225,000,000,000 kronen	84,434,000,000 kronen	37.6%

(2) PERCENTAGE OF WAR EXPENDITURES IN RELATION TO PEOPLE'S INCOME

Countries	*Annual Income*	*Average Annual War Expenditures*	*Percentage*
England ..	2,300,000,000 sterling	1,756,176,000 sterling	76.0%
France	37,000,000,000 francs	32,548,760,000 francs	88.0%
Italy	11,000,000,000 lires	7,503,266,000 lires	68.2%
Russia	15,000,000,000 roubles	13,527,150,000 roubles	92.0%
Germany ..	40,000,000,000 marks	34,144,787,000 marks	85.5%
Austria	25,000,000,000 kronen	18,178,160,000 kronen	72.7%

(3) PERCENTAGE OF WAR EXPENDITURES IN RELATION TO PEOPLE'S SAVINGS

Countries	*Annual People's Savings*	*Average Annual War Expenditures*	*Percentage*
England ..	370,000,000 sterling	1,756,176,000 sterling	468.3%
France	6,000,000,000 francs	32,548,760,000 francs	559.0%
Italy	1,800,000,000 lires	7,503,266,000 lires	416.6%
Russia	2,500,000,000 roubles	13,527,150,000 roubles	541.1%
Germany ..	6,500,000,000 marks	34,144,787,000 marks	525.2%
Austria	4,000,000,000 kronen	18,178,160,000 kronen	454.5%

In the World War, then, the Powers bore war expenditures amounting to 46 per cent of their national wealth on the average, 81 per cent of the people's income and five times the people's savings on the average as the average annual war expenditure.

The national capacity to bear war expenditures differ according to the economic structure and political situation of the particular nation concerned, and the above figures cannot be applied to all nations at all times. Granting this drawback, the application of the above standard upon Japan gives the following interesting results.

Japan's national wealth was estimated by the Government Bureau of Statistics at Y.110,100,000,000 at the end of 1930, and it may be safely estimated at Y.120,000,000,000 to-day. Using the above standard, 46 per cent of this estimated national wealth is Y.55,200,000,000, which means that Japan can bear at that rate an average annual war expenditure of Y.13,800,000,000 for four years.

In the next place, the Japanese people's income at the end of 1930, according to the same source, was valued at Y.10,600,000,000 and one may safely place it at Y.14,000,000,000 to-day.

Therefore, Japan can stand 81 per cent of this figure or Y.11,340,000,000 a year as war expenditures.

Lastly, the annual saving power of the Japanese people, according to Dr. S. Hijikata, Professor of Economics at the Tokyo Imperial University, is about 15 per cent of their income which would be roughly Y.2,100,000,000 on the basis of the above figures for the people's income. If this amount is multiplied five times, we have Y.10,500,000,000.

The above figures are based upon Japan Proper alone. If the figures for Chosen, Taiwan, and Manchuria are added, Japan can easily bear an annual expenditure of 14 to 15 billion yen. In the light of these figures, Japan, if forced to do so, can issue government bonds amounting from two to three billion yen several times a year and, even then, it still has enough reserve power left. It is for this reason that Finance Minister Kaya explained before the Special Session of the Diet that Japan's economic power is not so small as to tax its whole capacity in meeting the obligations of the China Incident.

From the above considerations, the assertion that Japan's economic strength cannot stand the burdens of the China Incident appears to be merely a sophistication. What, then, would be the possible effect of the Incident upon Japan's economic life?

Under the present unfavorable international balance of trade, Japan's international balance sheet would lose its equilibrium and invite a disastrous inflation if she should do nothing to meet the enormous amount of munitions and commodities required by the Incident. For this reason, the Government is proceeding cautiously in fashioning the national economic organization on a war-time basis. Its chief purpose is to maintain the equilibrium of the international balance sheet in facing the consumption by the Incident of an enormous amount of commodities and to help conserve the consumption of commodities which are not urgently needed so as to provide the commodities which are necessary for military consumption, and for the expansion of the productive capacity of munitions industries. Thus the Special and Extra Sessions of the Imperial Diet, besides approving the military appropriations totalling Y.2,500,000,000 took steps in legalizing various measures for war-time economic control. Among them, the most important are the Provisional Capital Regulation Law and the Provisional Export and Import Control Law.

The Provisional Capital Regulation Law aims to expand to the maximum limit, the productive capacity of munitions and related industries by regulating the capacity of munitions industries which is insufficient at present, thus enabling the proper digestion of enormous war expenditures and the ample production of munitions. It classifies the industrial activities of the country into three major classes: (*a*) those which are either directly or closely related to national defence; (*b*) those which are not vitally necessary at present, such as enterprises with overproductive capacities or industries turning out luxuries; and (*c*) those which do not belong to either one of them. It then recognizes in principle the new construction or the expansion of existing equipment only in (*a*) and not in (*b*) while it reserves the power to approve or disapprove the same in (*c*) in accordance with their relations with national defence or the international balance sheet at the time. It also extends the limit for the issuance of industrial bonds to Y.500,000,000 or twice the current limit, and thereby aids the supply of expansion funds by affording a favorable treatment to them. In this manner, it proposes to expand to the maximum limit the productive capacity of munitions and related industries.

The Provisional Export and Import Control Law invests in the Government the dictatorial power of supervising the trade on the basis of the following outline:

(1) The Government is authorized either to prohibit or limit exports or imports by signifying the period and goods if such is deemed necessary for national defence or people's economy.

(2) In the above cases, the Government, when it recognizes a special necessity, is authorized to order necessary particulars concerning the distribution or consumption of export or import goods upon exporters and importers.

The greatest problem which concerns the people's economy is, however, how much can the consumption of an enormous amount of munitions materials—war-time consumption and consumption for the purpose of expanding the productivity of munitions—and the supply and demand of commodities for the nation as a whole be modified and readjusted as a result of various policies adopted to assure them. The following points will become important in this connection. (1) What portion of the munitions consumption depends upon the imports and payment abroad? (2) How far can the internal supply of commodities be increased as a result of strengthening and expanding productivity? (3) How effectively can the control of the consumption of commodities through various methods adopted be realized? Some lights upon these points may be shed from the following considerations.

(1) As a result of a sudden increase in the importation of munitions materials this year, specie began to flow out of the country. This tendency must be eventually arighted. In this case, increased importation of munition materials must be met by prohibition or control of the importation of goods which are not vitally needed at the present time, thus effecting a proportional readjustment between the two.

(2) With regard to the internally manufactured goods, the goods which are not vitally needed now must be checked in proportion to increased consumption of munition materials. Actually, however, increased production caused by the expansion of productive capacity will naturally help lessen the amount which necessitates control. In this manner, a radical change is forced upon the substances for immediate consumption but, with the successful realization of increased productive capacities of munitions industries and industries for manufacturing substitutes for imports, import control would be mitigated and internal consumption revived.

(3) The above observations are based upon the supposition that the control of consumptions in the various fields can be satisfactorily enforced. The problem remains whether or not the enormously increased consumption of munitions can be met by the control of consumptions in the other fields.

At present the Government has adopted or is planning to adopt, roughly three methods for the control of consumptions: (1) postponement or economization by the Government itself of enterprises which are not immediately necessary; (2) suppression among the general public of new expansion programs in enterprises which are not urgently necessary; and (3) control of consumptions in general. These three methods must be enforced as one to be effective, but (3) appears to be the most important. (1) and (2) can be easily realized technically and are already being realized through several legislations, but the results so far are meager. This is naturally so, as the Government consumptions outside of military expenditures constitute a small portion in comparison with those of the general public. Moreover, room for economization is quite limited while the majority of general enterprises which are not urgently necessary already possesses an ample supplying power, and there is only a small need for new expansion. Moreover, the control of consumptions among the general public is at present largely practiced through the people's voluntary control, but, with the progress of the Incident, insufficient economization will appear in the form of constant rise in prices. As the rise of commodity prices above a certain level cannot be permitted, both from the point of view of the people's living standard and the execution of war, the Government, once sensing the rising trend in commodity prices, will try to control consumption by mobilizing all available methods. The Government and the people can co-operate closely in the future in meeting such a situation.

After considering the immediate effects of the China Incident upon economic circles, a question formulates itself as to the possible contribution which an enormous military consumption may have upon Japan's future economic development.

Generally speaking, two situations can be visualized in considering the effects of war upon the development of a nation's economy. The one is that of European countries after the World War, where, as a result of the War, each country received a heavy blow, invited malignant inflation and decrease of productive power, and experienced a penetrating impoverishment over a long period. On the other hand, the United States of America, although a belligerent Power, not only received an extremely light economic blow from the Great War, but, with the War acting as a turning point, rose from an erstwhile debtor nation to a creditor nation and underwent a remarkable transformation from a nation of agriculture and light industry to a nation whose national economy centered upon a high degree of heavy industry.

Such a difference in the economic effects of the World War may be said to be due to a shorter period of the American participation in the War and a comparatively smaller amount of military consumption. But the more fundamental factor appears to be the difference in the stages of economic development. The European countries arrived at the maximum point of industrial development before the Great War, and there was little room left for further development after the War. And thus, enormous unproductive consumption resulting from the War reacted as a destructive influence upon the national economy of various nations. Against such a position, the American industrial economy at the time of the World War was undergoing a transformation from that of an agriculture and light industry to that of heavy and chemical industry. Naturally, the consumption of a large amount of wartime commodities accelerated the development of heavy industries, and the nation, at the same time bearing a heavy war expenditure during the War, saw an amazing economic development after the War.

The present stage of Japan's economic development, though it differs decidedly in available resources, is in general similar to that of the United States at the time of the Great War. With the Manchurian Incident acting as a turning point, Japan's national economy has been undergoing a transformation from the age of agriculture and light industry to that of heavy and chemical industry. Without going into a detailed discussion of the subject. the following statistics* may be used as eloquent proof :

	1935			*1931*		
Industries	*Amount of production (Y.1,000)*	*Percentage*		*Amount of production (Y.1,000)*	*Percentage*	
Textile	3,352,560	30.9		1,926,800	37.2	
Metallic	1,881,740	17.4	47.2	431,430	8.3	33.7
Machine and Tool ..	1,462,530	13.1		498,010	9.6	
Chemical	1,813,870	16.7		816,550	15.8	
Total, including others	10,836,890	100.0		5,178,130	100.0	

Such being the case, Japan's industrial economy which is now gradually undergoing a transformation into heavy industry has a bright future ahead. In the light of such a background, the possible effects of the China Incident upon Japan's national economy may take the follow'ng form.

(1) A large portion of the military and war expenditures will act as a fund for protecting and accelerating the development of Japan's heavy and chemical industries.

(2) A large portion of the expanded munitions and fundamental industries, after replenishing the used munitions following the Incident, will be transformed to play a constructive rôle in peace-time industry.

(3) Japan's power of investing abroad will increase when her industry is successfully transformed into the new basis of heavy and chemical industries. For, under the present economic structure, the power of investing abroad is determined largely by the manufacturing power of capital materials (such as products of heavy and chemical industries) of a given nation.

(4) The Far Eastern countries are on the whole agricultural as yet, and industrial development is awaiting future attention. Naturally, the transformation of Japan's industry into heavy and chemical industries will find markets by offering capital aid to the industrial development in those countries. Moreover, the industrial development of those agricultural countries will increase their purchasing power and will in turn contribute much toward the expansion of Japan's export trade.

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*From the Industrial Statistics of the Department of Commerce and Industry.

Trends of the Warfare in China

By C. J. LAVAL

As 1938 starts down the uncharted way of the years into history it may be said, perhaps with some truth, that the outlook in stricken, war-torn China is not utterly hopeless. Dim and shadowy, to be sure, but still to be seen, are signs which indicate that the warfare between China and Japan may be approaching an end. At least there is talk about peace in the councils of the adversaries, and one may read in any newspaper reports of attempted mediation, of offers and counter-proposals, and of terms, acceptance of which would bring the tragic conflict to a conclusion. These elements in the situation were not present sixty days ago, and evidences are not lacking that both of the warring nations desire greatly and hope that the end of the conflict may not be far away.

The losses of this half-year of strife in China have been staggering, in lives, probably not fewer than a million, and, in property, uncounted hundreds of millions. And these losses are being shared, not only by Chinese and Japanese, but by all who live in the Far East, and the effects of the holocaust have penetrated into all the great nations, and to the farthest corners of the earth. Decades must pass before any large proportion of the material losses may be recovered. In these things is to be found the compelling reason why the conflict must be brought to an early end, because so long as warfare continues the losses in lives and property must go on mounting unchecked. The situation calls for a show of generosity, and of yielding, of concessions and of renewed effort to bring about a semblance at least of co-operation instead of destructive conflict. China has come to the places where she stands in danger of complete extinction as a power, and Japan ringed around with a coldly adverse world opinion, by continued expenditure of large-scale military effort, dangerously exposes herself to a powerful historic enemy armed to the teeth and charged with ruthless hatreds, held in leash only for the moment by fears at home.

Efforts at Mediation Fail

Efforts of the German Government to search out a common ground on which talk about peace might be opened, or to effect mediation to end the struggle, thus far have not yielded results. Exactly what have been the Chinese responses to the advances made by the German Ambassador at Hankow have not been made known in their entirety. Expressions of Chinese envoys, safe in world capitals remote from the scene of carnage, may be disregarded. Definite statements of leading figures in the Government located in transit at this time at Hankow are yet to be heard. Although the possibility may be remote, a possibility does exist that German efforts may yet bear fruit. Repeatedly leading representatives of the Japanese Government have declared that in this conflict Japan has no territorial ambitions in China. That this is true must be accepted ; it appears, however, that Japan may have set herself a more difficult task than to win territory, and this is an effort to conquer the mind of China, to modify the nation's mental viewpoint. This, in the light of all that has gone before, may prove far more difficult to achieve than any conquest of mere territory, for the Chinese live in the past, ever looking backward, venerating only forgotten eras whose standards they have lost. If their long and carefully fostered viewpoint with regard to Japan is to be changed, therefore, it would seem necessary first to imbue them with some new racial quality that hitherto has been lacking in their make-up. Traditionally they have hated and shrunk from alien influences, and, traditionally, most of all, they have hated their nearest neighbor.

It appears that the Japanese High Command in China has slowed down the advance up the Yangtze, a line of strategy probably determined long ago, but in line with counsel given in published German newspaper reports, which warned of dangers for Japan in too deep penetration into the interior of China. The tempo of operations in northern areas also has slackened in recent days, and the current main theater of warfare is in northern Kiangsu, Shantung, Anhwei and Honan, in north central China, almost within gunshot of the seaboard along the Tsinpu and Lunghai railways. Immense concentrations of China's best troops in this region are opposing converging Japanese armies along the Tsinpu railway, one Japanese force thrusting southward from Shantung and the other, having advanced from the region of Nanking, advancing northward. The objective of these Japanese forces is the strongly held railway junction city of Hsuchow located where the Lunghai and Tsinpu railway lines intersect. At the same time another formidable Japanese force pushing southward is aimed at Kweitch in Honan on the Lunghai line to the west of the rail junction at Hsuchow. Court martial and the firing squads probably await Chinese commanders who fail to give a good account of themselves in fighting in this region.

Major Conflict is Inevitable

At lowest estimates the impending struggle for mastery of these railways will involve a quarter of a million fighting men. Further victory here would give the Japanese undisputed control of the important north-south railway artery, the Tsinpu line, linking Shanghai, Nanking and the Yangtze with North China, and such a victory also would give control of at least the most important section of the less important Lunghai railway and its outlet on the seaboard.

At the time this is written it appears to be inevitable that this vast conflict now taking shape must be fought in the bitterly cold winter weather. There is likelihood that this may prove to be the decisive battle of the war, and it is improbable that any peace arrangements can be concluded before this fighting takes place. If the Japanese win control of the coastal railways and of the strip of territory along the seaboard, and if no peace then can be concluded, then it is probable that the arrow marking the Japanese aims will swing southward and point first at Canton. Then also the difficult thrust farther up the Yangtze may be resumed. All of this must necessarily greatly extend and make more vulnerable Japanese lines, imposing new and heavier burdens on Japanese resources than they have felt hitherto.

As time passes the chance grows more and more remote that the former Nanking Government will be able, from Hankow or from some other place in the interior of China, to engage in peace discussions with Japan—which might have been done in the weeks that followed the fall of Nanking. As the outcome of an Imperial Conference at Tokyo the Japanese Government, on January 16, formally announced the breaking off of relations with the former Nanking Government. Following this, the Chinese Ambassador and Chinese diplomatic officials departed from Japan for home, and the Japanese Ambassador in China was recalled. When the announcement was made of the break in relations with the Chinese National Government, the Tokyo Government clearly expressed the anticipation that in future diplomatic contacts would be established with a new regime in China. At that time Japanese spokesmen again declared that no change had been made in their Government's policy of respecting the territorial integrity and sovereignty of China, and the rights and interests in China of other Powers.

The autonomous government in Hopei over which so much controversy was raised, has been superseded by a Provisional Government in the northern Capital, whose historic name of Peking appropriately, many will say, has been restored. It is apparent that it is the expectation of Japanese leaders that the seat of government in China will be shifted back into Peking unless some eleventh-hour action can restore power and prestige of the regime of Generalissimo Chiang Kai-shek. Something of this sort is possible, but unlikely. It seems more probable that in coming weeks the authority and influence of the Provisional Government at Peking will be strengthened and that it will attain to some measure of permanency. With regard to the question of recognition of this Peking Government, which in time must arise, a singular situation exists.

New Roles for Old Actors

Many of the figures who compose this present Provisional Government at Peking, which assuredly will have to bear the stigma of being characterized a "puppet regime," were the same officials that composed the Government of China at Peking twenty years ago, long before the formation of the Nanking Nationalist Government. In these times these men and their Government at Peking had the recognition of the whole world as the rulers of China. The officials of the present Nanking Government in large part then were the outsiders clamoring for recognition that the Powers denied to the separate regime that they then controlled at Canton. It is to be seen then that if a shift in authority to a new Peking Government does take place, in the last analysis this amounts to nothing more than a shift in party control of the Chinese Government. It may be remarked also that in such a shift party lines remain unchanged, for the old Peking Government evidenced a degree of friendship for Japan and some more or less effective willingness to co-operate with the Japanese, while through those times, and since, the Cantonese regime and the Canton Government leaders consistently remained implacably hostile toward the Japanese.

The desire to bring to an end the costly and destructive war in China has been evidenced clearly by all elements in both China and Japan. Every reason that this warfare should be ended is apparent, and since neither side can hope to gain, but both inevitably must lose, if strife continues, every reason exists why the fighting should not be continued. Japan has announced her terms to end the war and it may be remarked that these terms are not so onerous as might be expected from a victor dealing with the abject and unconditional surrender of a vanquished adversary. There is no flavor in these terms of the kind of medicine that was administered at Versailles to Germany, for example. In an address before the Japanese Diet on January 22, Mr. Koki Hirota, the Japanese Foreign Minister, announced four "basic conditions" to bring an end to the conflict in China. These, he asserted, would be Japan's "minimum requirements." The four conditions are:

(1) Abandonment by China of her policy tolerating Communism and opposing Japan and Manchoukuo, and adoption by China of a policy of co-operation in the Japan-Manchoukuo anti-communist bloc;
(2) Establishment of demilitarized zones in "necessary localities" and creation of special regimes for those areas.
(3) Conclusion of an economic agreement between China, Japan and Manchoukuo, and
(4) Payment of "necessary indemnities" by China to Japan.

Japan, Mr. Hirota said, now looked "to the establishment and growth of a new Chinese regime capable of genuine co-operation with Japan."

Referring to misgivings abroad regarding Japanese intentions towards foreign interests in China, the Foreign Minister declared that Japan was "prepared for the purpose of promoting the welfare of the Chinese people to leave the door wide open to all Powers and to welcome their cultural and economic co-operation there" but "necessary and rational adjustments" designed to meet new conditions in China would have to be made.

Regarding Anglo-Japanese relations, Mr. Hirota hoped that the British Government and people, "grasping fully the importance" of the relationship between the two Empires would endeavor "to comprehend correctly Japan's position in East Asia."

United States Praised

The Foreign Minister paid high tribute to the "fair and just attitude" of the United States, which, he said, have acted "on all occasions with such careful regard for the cause of Japanese-American friendship that despite such mishaps as the Panay incident," the relations of the two countries had "suffered no impairment."

Referring to diplomatic exchanges between Japan and the Soviet Union, the Foreign Minister affirmed that Japan would "never allow" rights and interests derived from the Soviet-Japanese basic treaty "to be nullified through unreasonable pressure."

Concern was expressed by Mr. Hirota regarding the penetration by members of the Third Internationale of "all classes of Chinese, destroying the social order of the country and endangering the stability of East Asia."

"I desire to avail myself of this occasion to say that in Europe and in America, there are some who are apt to entertain misgivings regarding Japan's intentions, as though she were trying to close the Chinese door and expel the interests of the powers from China.

"Let me state explicity that not only will Japan respect to the fullest extent the rights and interests of the powers in occupied areas, but she is prepared for the purpose of promoting the welfare of the Chinese people to leave the door wide open to all powers and to welcome their cultural and economic co-operation.

"In conducting military operations in China, Japan has been exercising special care lest the nationals, rights, and interests of third Powers should suffer. But there have occurred, I regret to say, toward the end of last year, the Panay incident and the Ladybird incident, involving Great Britain and the United States.

"While it is needless to say that their occurrence was entirely unintentional, it was feared for a time that these incidents might lead to an alienation of feeling between Japan and those two countries.

"I rejoice that, thanks to the calm and fair-minded attitude taken by the Governments of both countries and the sincerity of our Government and people, the incidents have been brought in each case to an amicable settlement.

"Since the outbreak of the present affair, the United States have always maintained a fair and just attitude, acting on all occasions with such careful regard for the cause of Japanese-American friendship that despite such mishaps as the Panay incident, the relations of the two countries, I am happy to say, have suffered no impairment. We shall continue to do our best towards the furtherance of Japanese-American amity and goodwill.

Traditional Friendship

"As regards Great Britain, there has been no change in the policy of the Japanese Government which aims at the maintenance of the traditional friendship between the two countries. I hope that the British Government and people, grasping fully the importance of Anglo-Japanese relations, will endeavor to comprehend correctly Japan's position in East Asia and to co-operate with Japan for the furtherance of peace and good understanding between the two nations.

"At the same time, I desire to urge upon our own people to stand solidly behind this policy of the Government in view of the seriousness of general situation.

"It is earnestly to be hoped that the powers, by recognizing the new conditions prevailing in China and by appreciating the propriety of such Japanese demands, for necessary and rational adjustments, as have been submitted, or may be submitted hereafter, in order to meet those conditions, will co-operate for the establishment of a new order in the Far East.

"As regards our relations with Manchoukuo, it is the fundamental principle of our national policy to help that country to achieve healthy progress as an independent state, maintaining all the while its intimate and inseparable relationship with our own.

"In accordance with this basic principle, our government decided upon the abolition of extraterritoriality long enjoyed by Japan, and the transfer of her administrative rights in the South Manchuria Railway zone.

"I am glad to say that Japan and Germany have been brought closer together than ever through such auspicious events as the visit of His Imperial Highness Prince Chichibu, who was pleased to make a tour of that country on his way home from England last year, and also the cruise of H.I.J.M.S. *Ashigara*, which included a call at Kiel.

"Especially do this Government appreciate the friendly and most sympathetic attitude Germany has taken in consonance with the spirit of the German-Japanese anti-Comintern Agreement.

"We will strive to strengthen further the co-operation between the two countries.

"From the beginning of the present affair, Italy, understanding our true motives, has collaborated with us along all lines. This Government are most grateful for these proofs of good-will on the part of Italy.

"It is a subject for congratulation from the standpoint of securing world peace that Japan, Germany and Italy have come to join forces under the anti-Comintern banner.

Foreign Trade Good

"A survey of our foreign trade shows that there has been in the past year a notable increase as compared with the preceding year of more than 35 per cent in value, as regards imports, and 18 per cent in value, as regards exports, the total value of imports and exports together exceeding Y.7,270,000,000, which is an unprecedented sum in the history of our foreign commerce. Nevertheless there still remain economic barriers as heretofore.

"While endeavoring on the one hand to eliminate these obstacles through diplomatic means by dealing individually with various countries according to their respective circumstances and measures employed by them, this Government are exerting on the other hand unremitting efforts to promote our foreign trade by every means available. During the past year, trade agreements have been concluded with British India, Burma, and Turkey.

"There were also signed in December, a treaty of commerce with Siam and a supplementary agreement to the Italo-Japanese Treaty of Commerce relating to Italian colonies.

"Negotiations are now in progress with other countries for the conclusion of necessary trade agreements covering both old and new markets.

"A boycott of Japanese goods has been initiated in certain countries owing to misleading Chinese propaganda concerning the present affair and to machinations of Chinese who reside there in large numbers. However, nowhere has it developed into any serious proportions, thanks to the united efforts of the Government and people and the fair attitude of the general public in countries concerned.

"The Japanese Government believe it to be one of the necessary conditions of peace and harmony and prosperity of Japan, Manchoukuo and China, and consequently of the entire world, to increase rationally the productive power of those three countries and to strengthen their economic ties, and at the same time to promote their trade with the rest of the world.

"For the realization of this purpose, the Government are now carefully preparing appropriate plans at home and abroad.

Cultural Work

"Finally I desire to say a few words on cultural work. In order to promote international friendship and to bring about real peace among mankind, it is necessary that nations should form intimate cultural bonds and cultivate a full understanding of one another's ideals and aspirations.

"The present affair is traceable in no small degree to Chinese lack of understanding in this regard. If Japan and China are to build up a lasting friendship they should understand each other's national conditions and characteristics and co-operate culturally according to the fundamental spirit of the Orient.

"Taking this standpoint, the Government intend to carry on in China, more intensively than heretofore, cultural work which will serve as the foundation for permanent peace and prosperity of the two nations. At the same time the Government will not relax their cultural work elsewhere, since there is a special need in the face of present international situations of making other peoples better acquainted with our unique culture and the national traits of our people, who love justice and peace.

"I hope that form what I have now said you have been able to understand the views of the Government regarding the present China affair and foreign questions in general. In brief the underlying aim of the foreign policy of the Government is to eradicate the root of evil in East Asia, to make known throughout the world the justice of our cause, and to contribute toward laying the foundations of world peace.

"To that end, the Government are doing their very utmost. And I trust that you will appreciate the intentions of the Government and will extend your co-operation for the attainment of the objectives of our foreign policy in dealing with the grave emergency that confronts the nation to-day."

New French Air Bases in the East

Eastern Engineering and Commerce reports that, in order to strengthen her Far East defences, France plans to construct a big naval and air base at Camranh Bay, French Indo-China, and a secondary base facing Hainan Island, which China is fortifying. The *Sin Chew Jit Poh* says the proposed base at Camranh Bay is of particular importance to Singapore, because it lies directly on the air route to Hongkong. It is 900 miles from Singapore and 800 from Hongkong. While Britain, Holland and even Siam have spent heavily on their Far East defences, France has hitherto shown a tendency to lag. Now she is embarking on a scheme of modernization.

It is understood that twin-engined Amiot bombers will be stationed at Camranh Bay for coastal reconnaissance. France's aircraft in Indo-China are mainly out-of-date, although there are five modern flying boats at Saigon, where there is an aeroplane base and a military aerodrome, as well as a civil one.

Changing Siam

By SIR ROBERT HOLLAND, K.C.I.E., C.S.I., C.V.O., in *The Asiatic Review*

FROM north to south Siam is about 1,130 miles and from east to west about 508 miles, the area being about 220,000 square miles. The great Mekong River runs for a thousand miles along the northern and eastern boundaries, roughly speaking, though certain territories on the right bank were ceded to the French more than thirty years ago. The western flank of the upper part of Siam is formed by a range of mountains which continues southward to form the backbone of the Malay Peninsula.

The north part of Siam is a series of parallel ranges of hills lying north and south, between which flow four rivers which unite in the center of the country to form the main waterway, which is known as the Menam Chao Phya. The eastern part of Siam is a low-lying plateau, unhealthy and sparsely inhabited, because it is subject to heavy floods in the monsoon and is very arid in the hot weather. Central Siam is the heart of the kingdom, and is the most thickly populated and wealthy area. It is a great plain bordered by high mountains on the west and sloping gently to the sea on the south. In the flood season the Menam and other rivers overflow their banks and deposit a great deal of silt over the country, perpetually renewing the fertility of the fields, and thus is maintained the high reputation which Siamese rice has gained in the markets of the world.

Southern Siam, the part in the Malay Peninsula, is generally speaking a narrow, mountainous strip, of which a good deal is covered with dense forest, though there are small alluvial plains between the lower slopes. The coast on both sides of the Peninsula is studded with islands.

The Siamese have long called their country Muang Thai, or "the country of the Thai race," Thai meaning "free." The origin of the Thai race is very obscure, but there seems to have been a movement of the Thai peoples from south-west China at least two thousand years ago, and there were probably later waves of invasion from the same source, notably one about the middle of the thirteenth century, under pressure from Kublai Khan.

The Thai peoples absorbed a good deal of their remarkable culture from the Khmers, a mysterious race whose ancestors probably came from the plateaus of Central Asia. The Khmers built up a large empire, with its capital at Angkor, and kept the Thais in subjugation for centuries, building all over Cambodia and Siam, and farther afield still, the magnificent Hindu and Buddhist temples whose ruins are still visible to day. Eventually, however, they were overcome, and perhaps largely exterminated or driven southwards, by the Thais, who by the end of the thirteenth century had extended their dominion over most of the country to the west of the Mekong River.

But it was not till the middle of the fourteenth century, so far as we know, that the various Thai principalities were consolidated into a kingdom with its capital at Ayuthia on the Menam River. Four hundred years later, Ayuthia was stormed and destroyed by the Burmese, and in the sack of the city there undoubtedly perished most of the ancient historical records of the kingdom. Some few survived, however, being carried to the new capital which was established at Bangkok, where the present dynasty of Rulers, called the Chakri dynasty, was founded by a successful general.

The Portuguese were the first of the Western nations to establish intercourse with Siam. They arrived in 1511, after the conquest of Malacca by D'Albuquerque, and they exerted a powerful influence for over a century until they were gradually ousted by the Dutch. English traders arrived and were favorably received early in the seventeenth century, but it was not until 1824 that, after the conclusion of a treaty with the Dutch, British interests became paramount in the Malay Peninsula and Siam. The first treaty of friendship and commerce between Britain and Siam was signed by Captain Burney in 1826. Intercourse between France and Siam began in 1680, when a Siamese embassy was sent to Louis XIV., at the suggestion of a Greek adventurer named Phaulkon, who had raised himself by sheer talent to a position of great power at the Court of Siam, but eventually suffered a painful death on being suspected of forwarding French intrigues. The ruins of his splendid house are still visible at the old capital of Lopburi.

Japanese commerce was active in Siam from 1592 to about 1632, when many Japanese settlers were murdered or expelled.

Through the medium of Siam's early relationships with foreign nations, fascinating sidelights can be obtained on the history of the country before the beginning of the nineteenth century. A book recently published under the title of *Siamese White* is well worth reading, since it gives a remarkable account of the career of an Englishman who became *de facto* Governor of the Tenasserim Province of Siam under Phaulkon, and eventually, by his filibustering propensities, embroiled the Siamese Government with the East India Company. Most of the Englishmen in the Tenasserim port of Mergui were massacred by the Siamese in 1687, largely in consequence of White's overbearing and ruthless behavior, but White himself escaped to England with a good deal of loot.

Trade between British possessions and Siam grew rapidly during the nineteenth century, and in 1855 a treaty was made, signed by Sir John Bowring, under which Siam agreed to the appointment of a British Consul in Bangkok, and to the exercise by him of full extra-territorial powers. Similar treaties were soon made with the other Powers whose subjects were represented in Siam, with the result that foreigners in Siam, with the exception of Chinese, who have never been represented by a Consul, could only be tried for criminal offences or sued in civil cases in their own consular courts.

Towards the end of the nineteenth century the French complained that the Siamese were occupying territory which belonged to Annam, a part of French Indo-China. The dispute at one time seemed likely to have very serious results for Siam, but eventually the Siamese Government gave way and made various territorial and other concessions, and an Anglo-French convention was concluded in 1896, by which the central portion of Siam was neutralized, and in effect the independence of Siam was guaranteed by the two great Powers.

Further treaties were made with France in 1904 and 1907, by which the frontier between Siam and French Indo-China was finally settled and the extra-territorial rights enjoyed by France in Siam were to some extent modified.

By a treaty made with Great Britain in 1909, Siam ceded her suzerain rights over various Malay States situated in Southern Siam just north of British Malaya, containing in all about a million inhabitants, but obtained large concessions in the direction of the abolition of extra-territorial rights in respect of British subjects.

By treaties made after the Great War, mostly in 1925, the Powers agreed individually to their nationals being subject to the jurisdiction of Siamese State Courts, though certain jurisdictional limitations were to remain in effect until the publication of the Siamese codes of law, and for five years thereafter. In the case of Great Britain, for instance, there was an understanding that Siam would continue to employ a staff of British legal advisers, with a British judicial adviser at their head, who would sit in the special courts in which the cases concerning British subjects were heard, and also in the Appeal Court and the Supreme Court, during the interim period before all foreigners residing in Siam became subject to Siamese law administered in Siamese courts by Siamese judges.

Anyone who intends to visit Siam may be interested to have this slender foundation of knowledge before entering the country.

The best way to go to Siam is by sea via Penang, unless you travel by air. Crossing to the mainland from the island of Penang, you enter a comfortable international express train which takes you to Bangkok in twenty-seven hours. You pass at first through interminable rubber plantations, and paddy fields amid cocoanut palms, and dense jungle, with here and there the tidy villages of British Malaya. On entering Siamese territory, the scenery changes gradually and the line runs through endless cultivated plains and meadowlands, studded with groves of trees and villages and isolated limestone peaks that rise abruptly like forts from the plains. These are often honeycombed with caves which have gained a sacred reputation. Then comes a region of dense jungle and mountains, until the line returns to the seacoast and you get glimpses of sandy beaches and the blue waters of the Gulf of Siam. Inland are limestone cliffs which fringe the mountain barrier between Siam and Burma down the northern part of the Peninsula. At daybreak the international express reaches a little seaside station called Huahin, where the King has a fine palace, and there is also a charming hotel close to the sands with a good golf course close by.

If time permits, it is very advisable to stop off at Huahin and spend a few lazy days bathing in the warm sea, if the jelly-fish permit. They are sometimes very numerous, and an exudation from them causes painful and long-continuing sores. Besides the golf, there are some pleasant and interesting excursions to be made from Huahin.

Before a visitor arrives at Bangkok it is desirable that he should have some idea of the political situation in the country.

After the capital was moved to Bangkok, Siam was ruled by a succession of extraordinarily capable and intelligent kings, of whom the best known was King Chulalongkorn (1868-1910). In his reign the Government of Siam was modernized, and a reasonably efficient system of administration was extended over the whole country. Railway construction was begun, telegraph services were organized, the army and navy were greatly improved, a proper police force was constituted, social and educational reforms were inaugurated, the finances of the country were placed on a sound basis, arts and sciences, and in particular drama, were stimulated, and in fact Siam began to follow the example of progress which Japan had set for Eastern nations by opening its doors to Western civilization.

But the Government of Siam continued to be an absolute, though benevolent, monarchy. The King had a Cabinet Council consisting of the ten Ministers of State and a nominated Legislative Council of forty-five ; but he was an autocrat in practice as well as in theory, he had an absolute power of veto, and the initiation of measures rested largely with him. When King Prajadhipok came to the throne in 1925, he made some moves in the direction of delegation of powers and decentralization of work, and from royal announcements it is clear that he contemplated changes in the method of government which would enable his people to have a voice in matters affecting their interest and welfare.

But there were serious obstacles to be surmounted, and before the King was able to promulgate a scheme which he was understood to have prepared for introducing constitutional government, the so-called " Bangkok Revolution " took place on June 24, 1932, and a democratic body seized the reins.

The leaders of the revolution at first behaved somewhat discourteously to the King and the Royal Family, but later on they apologized for this, when they realized the King's readiness to play his part as a constitutional monarch and his sympathy with democratic aspirations, and when they remembered all that the country owed to the statesmanship of the Chakri kings and to King Prajadhipok in particular. The Princes of the blood royal were deprived of the many high offices which they had held, new Ministers were appointed, members of the Royal Family were declared to be above politics, in the sense that they could not hold political posts, and a Constitution was framed on scientific lines, following the most liberal models. A few months later, however, the Cabinet, dominated by some older and more conservative members, brought about the suspension of certain clauses of the Constitution and the prorogation of the National Assembly, and sent a prominent leader of the democratic party to Europe in virtual exile. These moves caused marked discontent among the younger politicians in Bangkok, and also in certain army circles, and a *coup d'état* was accordingly prepared.

It happened to be so timed as almost to coincide with my own assumption of my duties as judicial adviser to the Siamese Government. On June 19, 1933, I paid my respects to the State Councillor in charge of the Ministry, who seemed to me to be a charming and cultured man, but rather depressed and distrait. I never saw him again, and his depression may have been due to the shadow of coming events, for the *coup* came off on the next day, June 20, and when I went to the Ministry in the morning I found a lorry full of soldiers and machine-guns at the entrance, and the State Councillor had been removed from office.

The change-over was accomplished without actual violence. One set of Ministers went out, overawed by bayonets and machine-guns, and another set with more advanced ideas assumed office under the Premiership of a distinguished military officer, Colonel Phya Bahol. The Constitution was reintegrated, the National Assembly was summoned to meet again, and the leader, Luang Pradit, who had been exiled to Paris, was recalled. We immediately settled down to hard work, as the Government had a long list of reforms for every department of the administration which it was anxious to introduce as soon as possible. But a few months later there was a rude interruption when a rebellion broke out, led by Prince Bovaradej, who had a considerable number of supporters both in the army and navy. We foreigners in Bangkok were aware of a pitched battle proceeding on the outskirts of the city, but otherwise the even tenor of our daily lives went on as usual. The gunfire and the rattle of musketry gradually died away, as the rebels were pushed northwards, and after a week or two it was clear that the insurrection, which at one time had seemed likely to succeed, had definitely failed.

But on its collapse the Government found themselves confronted with some very difficult problems. The King, with his Court, had withdrawn southwards to Singhora, a town close to the British border ; many officers in the army and navy and in the civil administration were known to have sympathized with the rebels ; the gaols were full of prisoners of war and suspects ; some of the most experienced members of the Cabinet had resigned on the plea of ill-health ; and there was a general spirit of uncertainty abroad as to what the future might bring forth. If the King were hopelessly antagonized there might be a revulsion of popular feeling in his favor, because the sentiment of loyalty to the Ruling Family is deep-rooted in Siam ; if the prisoners were treated with ruthless severity, those responsible could expect no mercy, if a turn of fortune's wheel were to bring them into the same predicament later on ; if the army and navy and the administrative departments were purged of all officers suspected of leanings to the Right, on the ground of their association with the old regime, the machinery of government would be seriously weakened and a new body of malcontents would be created ; and finally the Assembly, which consisted of seventy-eight nominated and seventy-eight elected members, was not sufficiently representative of the people of Siam to confer any mandate on the State Executive.

The State Council dealt with these problems zealously but discreetly. They sent a delegation to the King, composed of the ablest Prince of Siam, who had thrown in his lot with the People's Party, by name Prince Varnvaidya, and the Minister of Justice, Phya Nitisastra, and these two, after long negotiations, succeeded in bringing about His Majesty's return to Bangkok and his resumption of the rôle of constitutional monarch, which he played with the same spirit as before. A few of the prisoners were sentenced to death and many to long terms of imprisonment, but the death sentences were not executed, either at the moment or later, and many suspects were released. Many officers in the armed forces and in the civil administration whose loyalty to the Constitution was doubted were replaced, but they were retired on pension and not dismissed. Skilful propaganda was started in order to educate the people to a realization of the advantages of the new era, much needed reforms were pressed on, and the full ventilation of grievances was encouraged in the Assembly, while at the same time any movement which seemed likely to be subversive of the Constitution was rigorously suppressed. Copies of the Constitution were conveyed to the more important towns throughout the country with ceremony that partook of religious ritual ; and every effort was made, especially by means of wireless talks, to kindle in the minds of the common people a real interest in democratic government and social reform. The movement had, of course, originated in Bangkok, though there were paler reflections in the larger up-country towns, but the country folk were politically apathetic, conceiving that the even tenor of their daily lives would be very little affected by changes in the personnel of the Central Government. Shortly after the second upheaval had taken place in Bangkok, a European who was travelling in Northern Siam was asked by a farmer to explain to him " what these people in Bangkok are quarrelling about, and why they seem to be getting so excited."

It is not easy to arouse enthusiasm for abstract political ideas in regions where communications are difficult and where the people are not under an oppressive yoke and can extract a sufficing, though slender, livelihood from the forests and the mud of the rice-fields.

There is no doubt, however, that a political change was necessary for very substantial reasons.

Before the revolution took place the King, with clear-sighted statesmanship, had planned the creation of a Constitutional Government on the same lines as in Western countries, so that the people should by right have a voice in the administration and in matters of policy affecting the general welfare. He realized that the Princes of Blood had gathered to themselves more than their fair share of power and privilege and reward, and that the administration, already top-heavy, was in danger of collapse. His Majesty's good intentions were, however, thwarted by the natural disinclination of his relations to divest themselves of prerogative, and his hand was forced by leaders of the People's Party whose patience was exhausted.

Those leaders were highly intelligent men who had imbibed deeply of Western education, many of them having been actually trained at the expense of the State in Europe or America. They deemed themselves wholly competent to occupy the highest positions in State service, from which they must assuredly be excluded so long as the Departments were in the grip of bureaucratic Princes, and they were filled with burning desire to save the country from decline by introducing long-needed reforms. The new wine was fermenting in old bottles, and it was inevitable that pent-up feelings should find a release in order that greater danger might be avoided. There were already signs of the subtle workings of communism in the larger cities.

The requirements of the situation and the nature of the ills which existed may be gathered in some measure from the terms of the Constitution which the revolutionaries set up, and from the six "Principles" which they declared would govern their policy. These "Principles" were concerned with—

(1) Equality of Rights
(2) Liberty
(3) National Independence
(4) International Law and Order
(5) Economic Progress
(6) Education

The Government hold that equality of rights and liberty for the people are assured by the Constitution itself, with its fundamental declarations and the charter which it gives to the People's Assembly. The State Council have been hammering away at the remaining points during the past three years by administrative measures and by a spate of legislation.

I will not at the moment attempt to assess what measure of success they have achieved.

To resume the narrative; the King spent some months in his garden palace in Bangkok, and his presence, while affording invaluable support to the Government during the consolidation of their victory, undoubtedly restrained the hotheads of the People's Party from pressing for stern vengeance upon those captured in the insurrection. The King's visit to the capital at this critical time proved to the leaders of the movement, if they still entertained any doubt on the subject, that he was opposed to any attempt to reinstate the absolute Monarchy (a plan which Prince Bovaradej is believed to have entertained), and the loyalty and veneration displayed during his public appearances probably convinced them that, for the time being at all events, the Sovereign was a necessary feature in the Constitution. The King's retirement to the proximity of the British frontier during the fighting was probably a wise step, since he would have been a pawn in the hands of any party that could have controlled his movements at the time, and he would have been compelled to descend into the arena of politics, thus perhaps imperilling the existence of the Monarchy.

But His Majesty's health was giving cause for anxiety; he had been warned that an operation for cataract would shortly have to be performed upon one of his eyes, and the whole affair of the insurrection must have involved a severe strain at a time when he should have been conserving his strength.

He probably realized that after his presence had produced the calming effect that was so urgently required, his position might become very difficult, since he would be a target for complaints, and discontented persons might try to focus their intrigues upon the throne. He could exercise very little direct influence upon the decisions of the State Council who had disregarded his offers of mediation, and he may have been impressed with the belief that he would be acting in the best interests of Siam and the Monarchy if he absented himself from the country for a time.

In any case, it would have been dangerous for him to have had the cataract operation performed in Bangkok, even if the presence of skilled specialists could have been secured, because he could not have obtained there the several months' rest and recuperation which the doctors had told him must be regarded as the necessary preliminary to the operation.

So he left for Europe in the spring of 1934, and a Council of Regency was appointed.

The Siamese possess a peculiar talent for the arrangement of colorful and dramatic ceremonial, and Their Majesties' departure from Bangkok by river was an unforgettable scene. The Diplomatic Corps and the Princes and nobles and the high officials, with the ladies of their families, all brilliantly arrayed, were gathered on a dais under a high roof of colored tiles which was supported on slender pillars. The far end of this open hall was arranged like the chancel of a church, with an altar bearing many lighted candles and Buddhist symbols of worship, while down the side priests sat cross-legged, chanting perpetually in deep voices and waving their fans. Outside, in orderly blocks, were grouped the lesser folk, under marquees or on chairs in the open, one block on the right of the landing-stage being reserved for the members of the Assembly, who made a somewhat drab patch in their work-a-day clothes. Guards of honor lined the path to the landing-stage, and troops with their bands filled the background.

At last Their Majesties appeared, the King in full uniform with decorations, leading the Queen by the hand. After passing down the hall, and after performing the customary ritual and presenting gifts to the priests, they knelt for a time on cushions before the altar, and then, after taking farewell of close friends, they walked slowly to the landing-stage under the shade of the royal umbrella and followed by their staff. After Their Majesties had entered their speedy motor-yacht, it proceeded a short way up-stream, and then turning flashed past the crowd, by this time assembled on the bank, at full speed on its way to the ocean steamer anchored down river. So King Prajadhipok bade farewell, and in all probability a final farewell, to his capital of Bangkok.

A year later the King, while residing in England, signed his formal act of abdication. For reasons which seemed to him to be of the greatest importance, he had refused to sign the death warrant of those condemned after the insurrection; he had protested against the policy followed by the Government on the ground that it failed to give political freedom to the people; he had strongly objected to the provisions in the Constitution whereby half the members of the National Assembly were to be nominated by the Government—i.e., by the party in power; and he forcibly condemned the procedure followed in political trials, and participation in politics by officers of the army and navy in active service.

The Government, in disregard of the royal veto, passed an Act to make unnecessary the King's assent to executions, and they showed no disposition to accede to the King's wishes in other matters, doubtless because they were convinced that their only hope of maintaining order and retaining power in their own hands lay in exercising the closest control, not merely over the machinery of government, but also over the deliberations of the Assembly, through the obedient bloc of nominated members.

Part of the army and navy still wanted their King back, and the masses of the people, if they could have had a free vote, would probably have given it in his favor, but the Government could not trim their sails without danger of foundering, and they held on their course. They sent a mission to Europe to negotiate with His Majesty, but there was never any real possibility of compromise.

After the King had failed to receive the definite answers which he considered were required by his definite demands, he dispatched his abdication on March 2, 1935, accompanied by a public statement to his people, in which he said that in his view—

> "the Government and its party have employed methods of administration incompatible with the personal liberty of the subject and the principles of equity according to my conception and belief. I am unable to agree that any party should carry on administration in this way under cover of my name."

He accordingly renounced all the rights which he had as King, and abandoned also his right, under the Succession Act, to nominate his successor. The abdication was accepted, and Prince Ananda Mahidol, the first in the line of succession, was invited to take the throne by the State Council with the approval of the Assembly.

In the meantime life in Bangkok had jogged on much as usual. The machinery of administration functioned with reasonable efficiency, the people observed their usual feasts and holidays, the life of the countryside flowed in its usual peaceful channels,

(Continued on page 18)

The Shuikoushan Lead-Zinc Mine, Central Hunan, South China

By C. Y. HSIEH, Geological Department, National University of Peking; Division of Mineral Deposits, National Geological Survey, China, as published in The Journal of The Association of Chinese and American Engineers

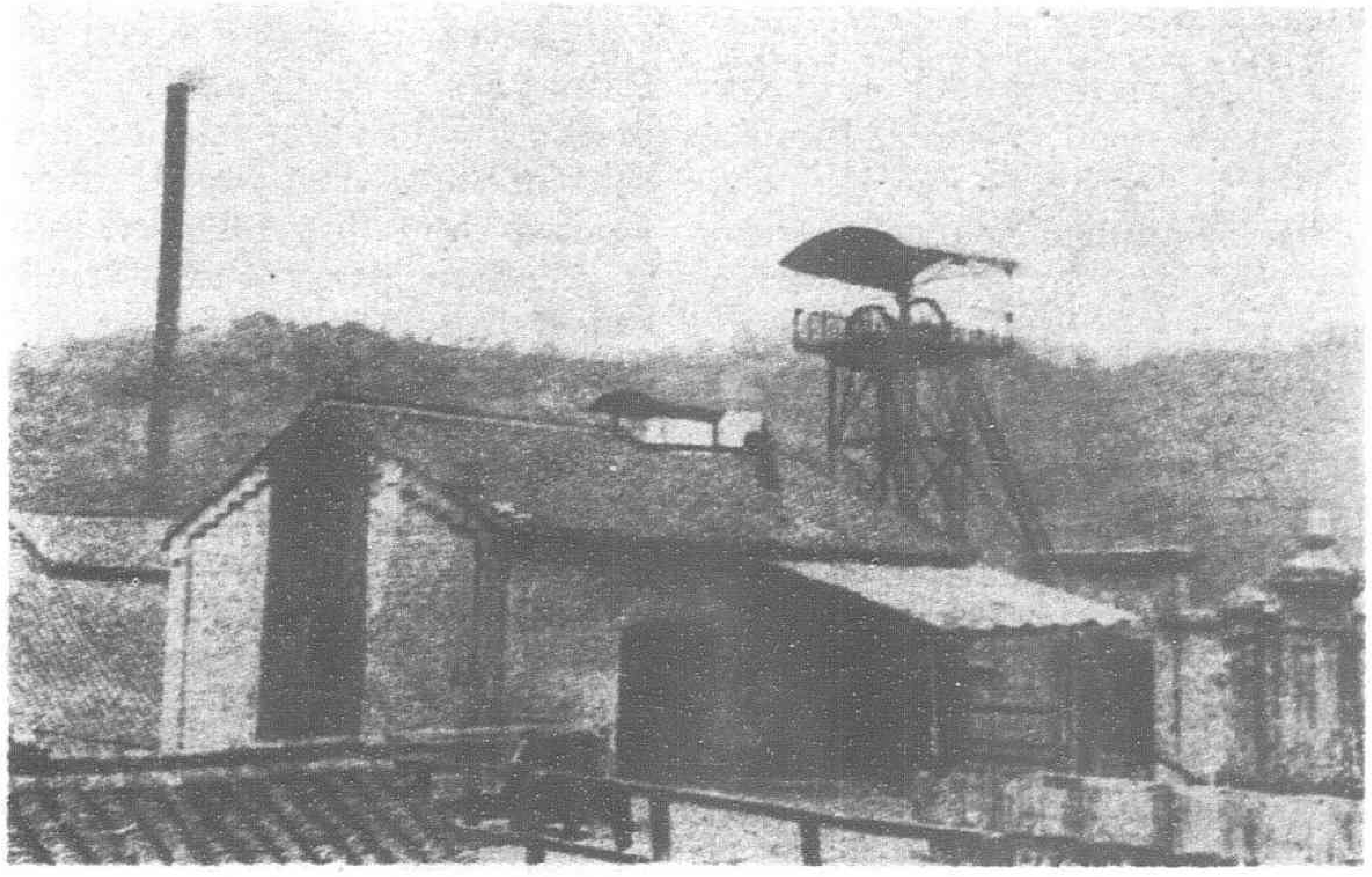
In my report on the lead-zinc deposits of central Hunan published in the *Geological Bulletin No. 29 of the National Geological Survey*, I have described in some detail the geology and ore deposits of the Shuikoushan lead-zinc mine. Particular attention was paid to the genetic aspects of the deposit, which have been obtained from careful field observations as well as microscopical study of the ore specimens.

In the spring of 1937, the writer assisted by Mr. H. C. Chu went again to the district for a more detailed study of the ore bodies. At the same time attention was directed to the finding of some promising localities where new ore bodies might be discovered.

This paper is intended to present in a more concise form the principal geological and metallogenetic features of the deposit. The new data collected during the latest trip are also included which tend to supplement or correct some of my previous conclusions.

Location

The Shuikoushan lead-zinc mine is situated south-east of Changning or about 40 km. south of Hengyang. From Sungpai, a port on the Hsiang River, it is only five km. distant and between these points a light railway has been built by the mine company. Direct water transportation from Changsha via Hengyang to Sungpai is also possible at all seasons of the year, the total distance being about 310 km. Since the construction of the highway, motor-bus service is now available from Changsha to Hengyang taking about half a day. From Hengyang to Sungpai, a distance of 35 km., the region may be reached in one day's journey on land, but the return trip can be more comfortably made by native boat, which, taking advantage of the down current, usually takes overnight to reach Hengyang City.



No. 1 Mine, showing the head-frame of the incline looking south-east

Topography

The Shuikoushan district presents a rolling hill topography with the highest summit not more than 250 m. above the adjoining plain. The elevation decreases gradually from west to east and from north to south. In the east it is bounded by a broad valley, on the other side of which lies another group of hills that may be collectively called the Meishanling Hills. In the north it merges into low hills of red sandstone and red clay stretching as far as the banks of the Hsiang River.

The surveyed area comprises the higher hilly region of sedimentary rocks to the west and the south and low and rolling hills of deeply weathered quartz monzonite in the center, and a belt of still lower hills of red sandstone and red clay in the east and the north. The geological nature of the different terrains is well reflected in their topographic expression, so that in a view from any of the higher summits, the different geological formations may be easily distinguished.

As can be seen from the accompanying map (Plate 1), the region is dissected by several alluvial valleys in the north, and it is in one of them that the Shuikoushan mine is located. In the south there is the valley of Lungwangshan in which are situated the famous breccia pillars Yaochienshu and Chupaomeng and the long-abandoned Lungwangshan mine.

To the immediate north of the Shuikoushan mine is a red-colored low hill with abundant waste dump on its southern slope. This hill has no name and is herein called North Hill. A little north of it is another hill, on the top of which a police station is situated and is here called Police Station Hill. South-west of No. 1 mine is the hill Sinwuling with a little house on its top.

Stratigraphy

In the report of 1937, I have classified the rocks of the Shuikoushan Hills proper into the following formations : (*a*) Quartzite and shale ; (*b*) Limestones ; (*c*) Coal series ; (*d*) White sandstone and siliceous shale ; (*e*) Red beds and red clay ; followed by the quartz monzonite intrusion.

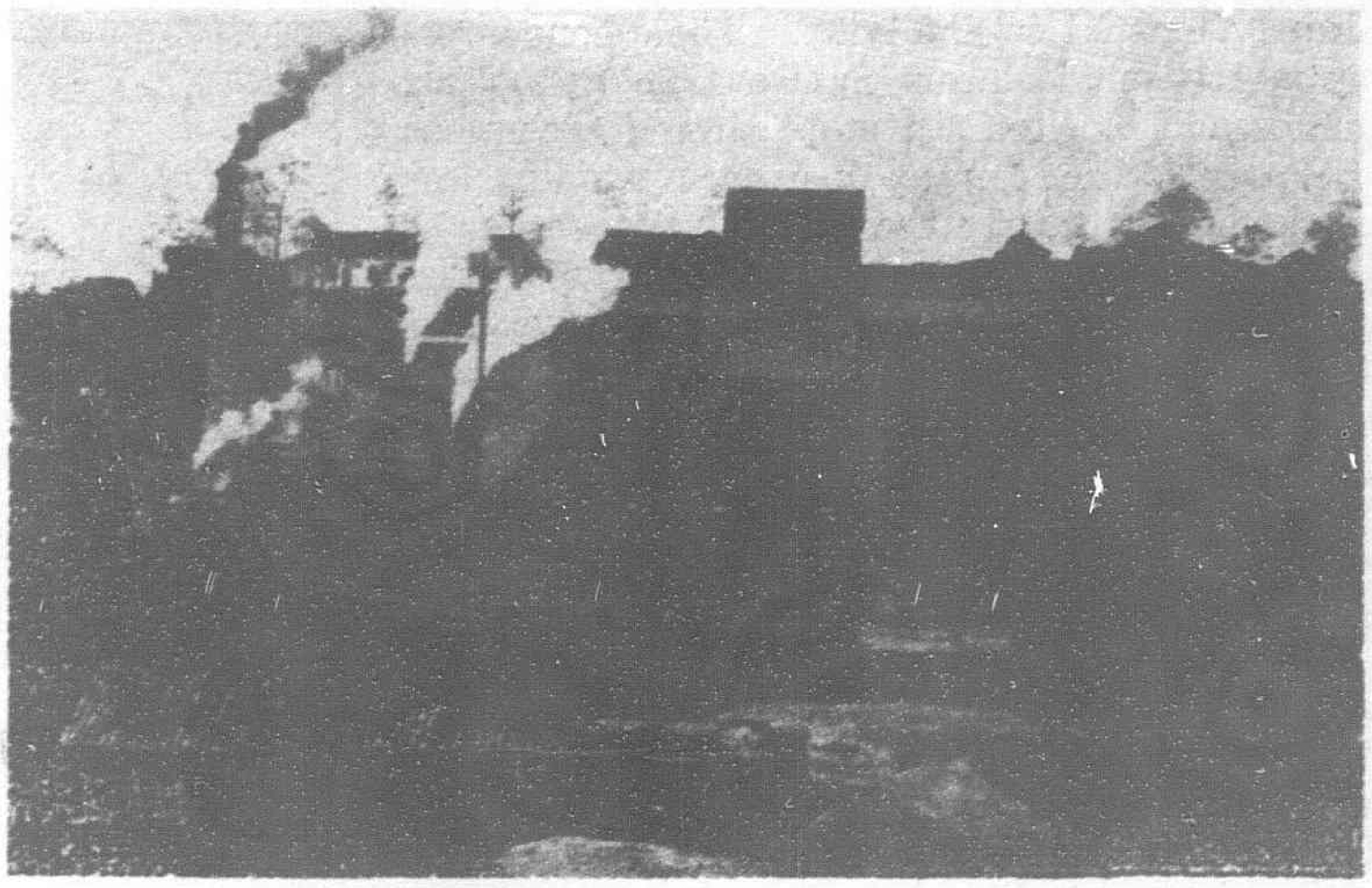
In the latest investigation it has been shown that the formations exposed on both sides of the monzonite laccolith are not the same, the one on the west being evidently older. This formation consisting of quartzite and shale, was assigned to the Silurian by Liu and Tien. This conclusion is, however, not justified since fossil evidence is lacking. It is very probable that the formation in question belongs to the Lower Carboniferous. This is based on a correlation of lithological characters with the stratigraphical column recently established by the Huan Geological Survey. The formations exposed to the north, east and south of the laccolith, with the exception of the red beds and red clay, all belong to Permian. This latter conclusion is supported by fossil evidence. The stratigraphic column thus revised may be stated to be as follows :

(*a*) *Lower Carboniferous quartzite and shale*—This is a thick formation of hard, massive quartzite intercalated at several horizons by yellow sandstone and shale usually thin bedded and friable. No fossils have ever been found, but it is without doubt that it lies underneath the Permian formations to be described later. The formation shows a prevailing dip towards the east at a moderate angle, and then changes to an eastward dip at about several hundred meters west of the Shuikoushan mine, thus forming an anticlinal structure. The same formation extends further west for at least a couple of kilometers. The base of the formation is thus not exposed and its total thickness cannot be estimated. The exposed portion in the Shuikoushan Hills proper must amount to no less than 500 meters.

(*b*) *Permian limestone*—This forms the country rock of the lead-zinc ore bodies and also the base of the Permian formations shown in the surveyed area. Outcrops are, however, very scarce, being found only in a few scattered exposures on the southeastern slope of North Hill. The limestone is mostly metamorphosed into marble, containing at some places contact-metamorphic minerals, like garnet and diopside, the latter having again been altered into chlorite which accounts for the light green color of the rock.

In the underground of all the shafts and inclines developed by the mine, this same limestone which has been entirely metamorphosed into marble constitutes the predominant rock. Its contact with the quartz monzonite can be well seen on the third level of No. 1 incline as well as in the drifts of No. 2 shaft. The contact zone about 50-80 m. in width is rich in diopside and garnet both of which have been partly altered into chlorite showing thus

No. 2 Mine, showing the vertical shaft looking west



Ore dressing plant

a spotted color of light and dark green and brown. On the waste dump of the Tsingshuitang prospecting ground, about one km. south-east of the mine, marble and garnet rocks are abundant, besides the fresh pieces of quartz monzonite. Thus it can be inferred that here also limestone constitutes the principal formation in the underground.

Thus defined by the underground observation, the limestone area forms a narrow strip measuring from Laoyaochao, the eastern end of the mining town, to Sinchung, a distance of about 550 m., though its western limit in the direction of Sinchung has not yet been reached by underground working. Its width from north to south seems not to be considerable, being about 250 m. at most. The underground distribution of limestone at Tsingshuitang is, of course, not known, though it is quite probable that it may extend in a north-south course for some hundred meters.

No fossils have ever been found in the limestone beds. On the other hand indirect palæontological evidences are available. In the basal conglomerate of the Red Beds, north-west of the mine, pebbles of marble evidently derived from the same limestone formation of the west show on their weathered surfaces abundant remains of corals and *Fusulina*. The best specimens can be obtained from the north slope of Police Station Hill not far from the railway track. These fossils, though not yet carefully studied, are quite sufficient to show a possible Permian age of the formation.

Since all the limestones have been metamorphosed into marble, a distinct recognition of their dip direction becomes very difficult. On the southeastern slope of North Hill, one small outcrop of limestone seems to show a northwestern dip at 30-40 deg. In the underground some of the marble, especially in the eastern part of the working, shows not infrequently a laminated structure of white and gray. These laminations may in some cases indicate the original bedding of the limestone and they, therefore, have been carefully measured wherever they appear.

(*c*) *Coal measures*—These are composed of gray quartzose sandstone, black shale, lenticular layers of limestone and seams of anthracite. The limestone lenses are gray and dark gray in color and are rich in brachiopods and other fossils. They are exposed at Maochiashan and its vicinity, south-east of Lungwangshan, where several native pits have been opened up to mine the coal. From the last-named place the formation seems to extend towards the south-east for some distance but it has not been traced.

A casual examination of the fossils collected from the limestone lenses reveals an undoubted Permian age. The thickness of the exposed part of the series amounts to about 100 m.

(*d*) *Chert, sandstone and siliceous shale*—Several outcrops of chert beds are found north of the Shuikoushan mine. On the northern slope of Police Station Hill and behind a house a series of chert and yellowish-gray shale is found below the red clay. The beds are quite crushed and contorted, but a prevailing dip towards north-east at about 65 deg. can be observed. The chert shows some indications of *Fusulina* and the shale contains some poorly preserved brachiopods. Further north at the immediate vicinity of the railway track, a continuous bed of chert is again exposed dipping steeply (70 deg.) to east of south-east. Between Tsinghsuitang and Lungwangshan there occurs a continuous exposure of siliceous shale and sandstone; whether this represents the equivalent part of the chert beds just named, or separate horizons, is not yet certain. Besides the temple Lungwangmiao, south-west of Lungwangshan, a narrow strip of fresh and unaltered limestone occurs. The limestone, only about one foot in thickness, and occurring evidently in lenticular form, is interbedded with the siliceous shales. A spring issues at the place where the limestone crops out. This limestone forms, therefore, only a part of the siliceous shale and has nothing to do at all with the great limestone formation underlying the mining town on the north.

(*e*) *Red beds and red clay*—Unconformably overlying the Permian strata is a series of red sandstone and shales with a conglomerate at the base. Generally speaking the series consists of more shale than sandstone in the upper part and less shale and more sandstone in the lower one. Owing to absence of fossils, the age of the red beds is not known. It has been variously assumed to be late Cretaceous or late Cretaceous to early Tertiary.

The red beds occur on the eastern and northern portion of the Shuikoushan Hills forming there a series of low foothills. The basal conglomerate has few outcrops, being found north-east and east of the mine. In the eastern end of the A level of No. 1 mine a drift has penetrated through a hard and compact basal conglomerate which here shows a dip of No. 70 deg. E. at 40 deg.

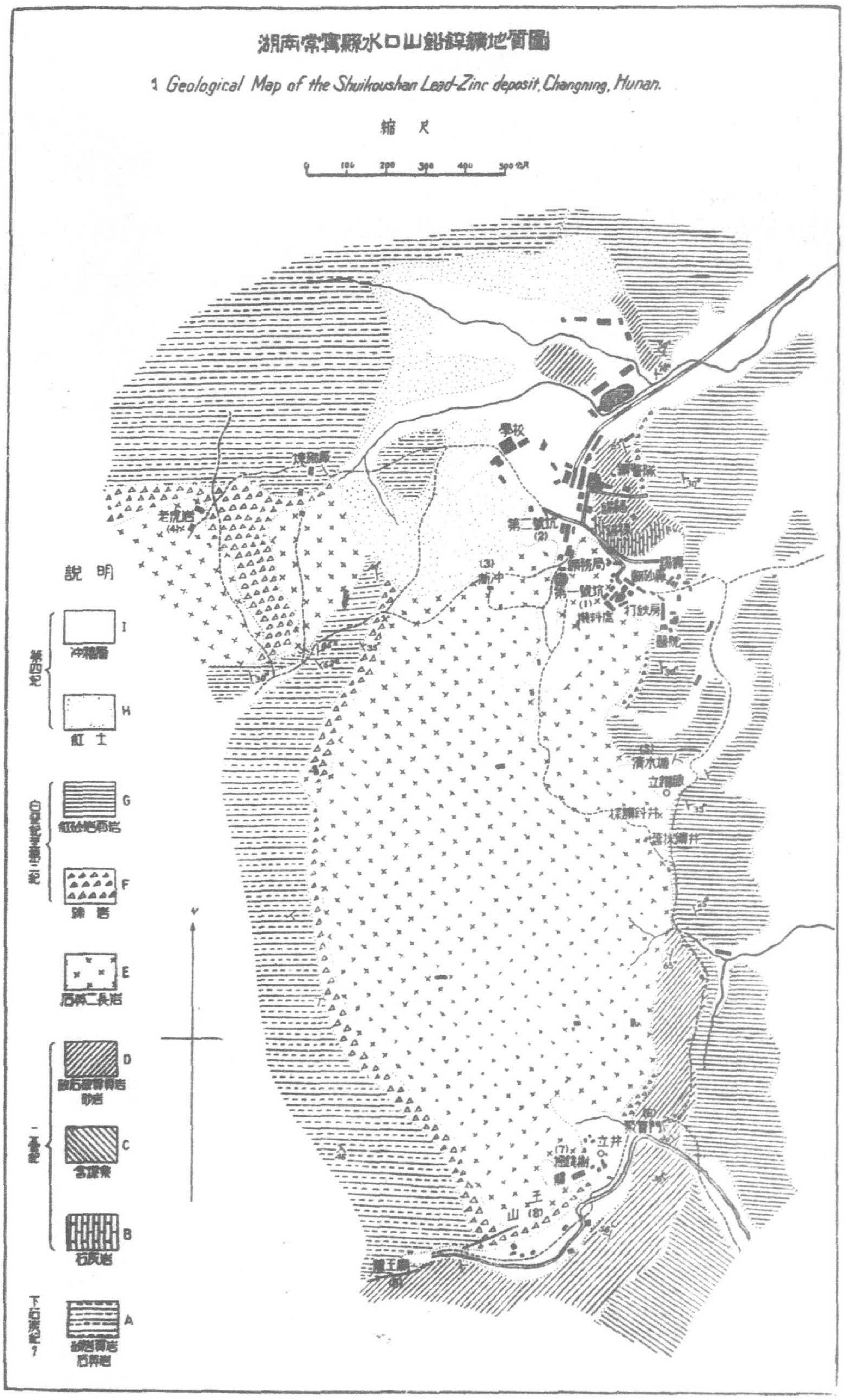
The pebbles of the conglomerate consist enirely of marble, a fact conclusively proving that by the time of the deposition of the basal conglomerate, all the limestone had been metamorphosed into marble; in other words, the red beds must be of post-intrusive age. The beds have been indurated and tilted to an inclination of 30-50 deg. indicating that orogenetic movement was rejuvenated after their deposition.

Practically all the red clay here is of residual origin. Conspicuous exposures of such clay are found north and north-west of the mine thus masking and covering all the underlying structures. The occurrence of red clay is irrespective of elevation; it has been found on hills more than 100 m. high. This feature differs markedly from the red beds which usually form low hills in this region.

The Quartz Monzonite Intrusion

The central portion of the Shuikoushan district is occupied by a laccolithic intrusion of quartz monzonite measuring about 1,800 m. from north to south and 900 m. from east to west. The outcrops are intensely weathered. Fresh specimens can only be obtained from underground or from the waste dump of the Tsingshuitang prospecting ground.

The rock shows a medium-sized granular to porphyritic texture and consists of quartz, orthoclase, plagioclase (oligoclase andesine), and biotite as principal constituents with sphene, apatite, magnetite chlorite and pyrite as accessory ones. When fresh the rock is hard and compact with feldspars slightly altered to kaolin. It shows a mottled color of red (orthoclase) and black (biotite). In all specimens studied, the biotite, often with minute inclusions of zircon, has been partly or wholly altered into chlorite. In the porphyritic phase, the ground mass is made up essentially of fine-grained quartz mixed intimately with other secondary products. This quartz aggregate is derived partly from silicification and partly from the granulation of original quartz which



1 *Geological Map of the Shuikoushan Lead-Zinc deposit, Changning, Hunan.*

English version of Chinese localities

(1)	**No. 1 Mine**
(2)	**No. 2 Mine**
(3)	**Sinchung**
(4)	**Laohuyen**
(5)	**Tsingshuitang**
(6)	**Chupaomen**
(7)	**Yaochienshu**
(8)	**Lungwangshan**
(9)	**Lungwangmiao**

Geological formations

I. **Alluvium** } **Quaternary**
H. **Red clay** } **Quaternary**
G. **Red sandstone Cretaceous to Tertiary and shale**
F. **Breccia**
E. **Quartz monzonite**
D. **Sandstone, siliceous shale and chert** } **Permian**
C. **Coal measures** } **Permian**
B. **Limestone** } **Permian**
A. **Quartzite, shale and sandstone—Lower Carboniferous**

already existed in the rock. The phenocrysts are mostly plagioclase with also some orthoclase, quartz and biotite. In more altered specimens the porphyritic texture becomes usually less marked, with nearly the total disappearance of both the feldspars and biotite phenocrysts. The whole mass is now composed of a fine-grained aggregate of quartz and feldspar mixed with such secondary products as sericite, kaolin, chlorite, etc. Pyrite is evidently of secondary origin occurring either as disseminations or as filling of fractures. Veinlets of secondary quartz together with calcite are also present. In the extremely altered type, such as is found on the surface, it is simply a soft kaolin rock, deprived of almost all its igneous structure, and it may be easily mistaken for a weathered marble. This becomes more so when the joint system of the rock is still retained, as is beautifully displayed in the valley of Chenchichang native mine where one may at first mistake it for a series of bedded rocks.

Geological Structure

Owing to the incompleteness of outcrop, the masking of red clay and above all the disturbing effect of the igneous intrusion, the geological structure of the Shuikoushan district does not appear at all simple. My previous interpretation that it consists of a faulted syncline, seems at present no longer valid.

The general structure of the region may now be considered as an eastward dipping monocline with Lower Carboniferous quartzite, sandstone and shale at the base, followed in succession by limestone, coal-measures, siliceous shale and sandstone, and chert, all being of Permian age. The stratigraphic position of the chert is not quite well determined, although it is probable that it may form the uppermost member of the Permian formations.

At North Hill, the chert beds are observed to lie with a gentle discordance on the limestone. This may be taken as an unconformable contact, but it is more probable that it represents an overthrust fault. In the south the structure is further complicated by a strike fault, which is here named the Lungwangshan fault. Its existence is inferred from the abrupt and discordant contact of the Permian sandstone and shale against the Lower Carboniferous formation west of Lungwangshan. In the underground many slips or fractures of inconsiderable signficance were observed.

The limestone block in the north which has been the key point to the localization of the ore bodies, represents the northern flank of the intrusive mass. It extends southwards as far as Tsingshuitang. Its relation with the underlying Lower Carboniferous formation is not clear, as no direct contact is exposed. The limestone itself forms probably a synclinal structure, its axis being somewhere to the west of Sinwuling and maintaining an approximately north-south course. This conclusion is supported by underground observation on laminated structure in the limestone. To the east of the hill referred to all the laminations measured underground (on second, third, fourth, fifth, and sixth levels) show usually a north-west or south-west dip, while west of the hill (on the third level), a reverse direction towards the east was observed. Further towards the west in the No. 2 shaft and Sinchung area, laminations are conspicuously absent, so that no further clue can be obtained. The absence of any limestone block in the rest of the region may be explained by the action of subsequent erosion, or partly it may have been removed by the dissolution and assimilation effect of the monzonitic magma.

Another structural feature worthy of notice is the presence of a breccia nearly all around the igneous intrusion forming such conspicuous hills as Yaochienshu and Chupaomen. Most of the breccia is rich in pyrite so that on oxidation it shows a bright color of red and yellow and may be rightly called iron gossan. The breccias are composed of angular fragments of white quartzite, sandstone or siliceous shale, all being extensively silicified and often densely penetrated by veinlets of well-crystallized quartz and pyrite disseminations. Although the breccias are lithologically indiscriminable, they belong to different formations; thus in the west they are derived from the Lower Carboniferous formation, while on the south they originate from the Permian series.

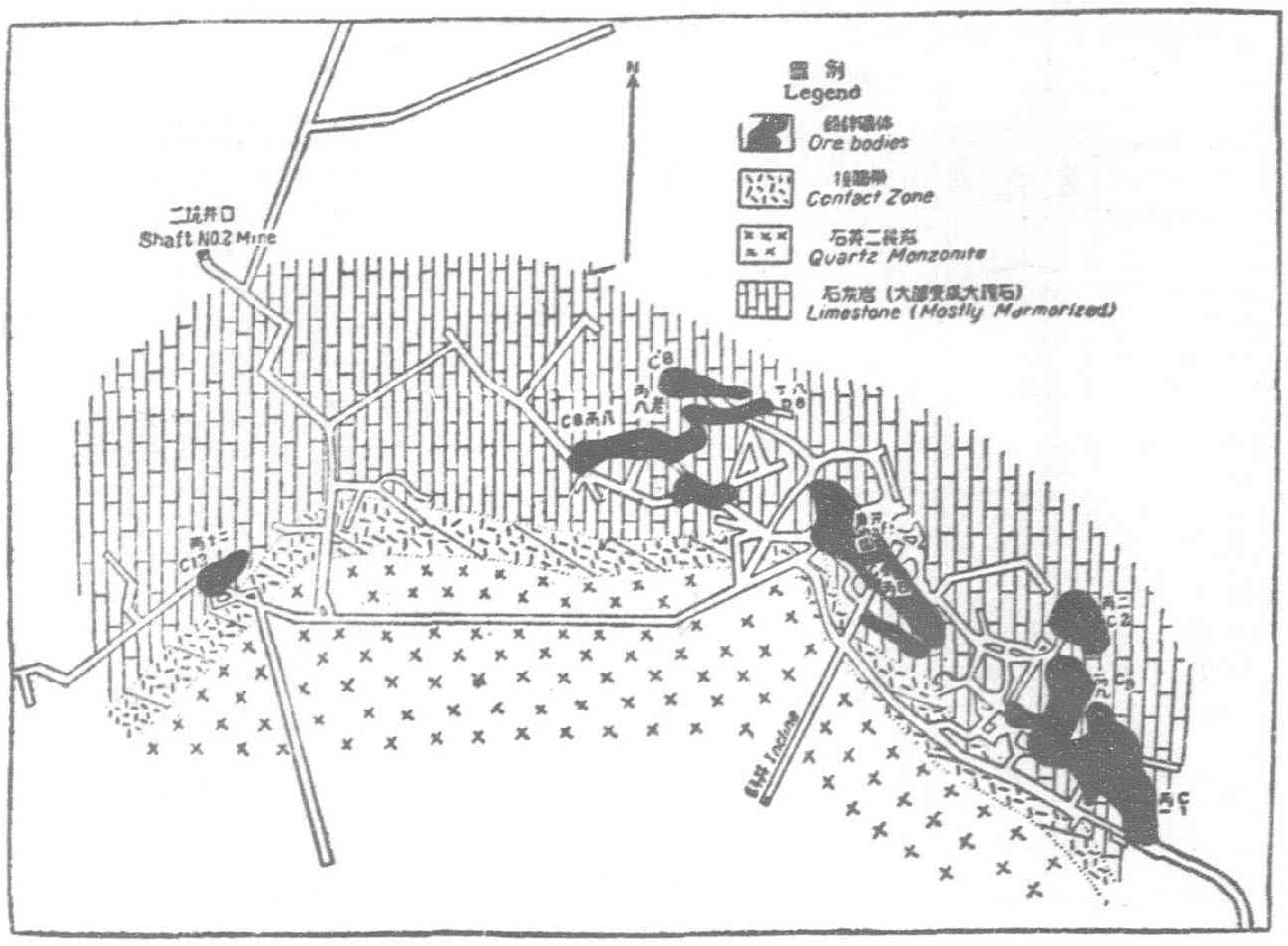


Fig. 1—Underground geological plan of the third level, No. 1 Mine of the Shuikoushan lead-zinc deposit, Changning, Hunan

Rock Alterations

The Permian limestones of the Shuikoushan region, both that in the underground and that on the surface, have been metamorphosed into marble of white or greenish color. At its immediate contact with the quartz monzonite, a metamorphic silicate zone 50-80 m. in width, is found. This zone is shown in practically all the underground levels, but on the third level of the No. 1 mine, it is especially distinct, as here the igneous rocks are well exposed. Rocks from the waste dump of the Tsingshuitang prospecting ground and on the southern slope of North Hill, north-west of the Hsishou mine furnished especially good material for microscopical study of the contact zone.

Garnet, diopside and quartz are the principal minerals in the contact silicate zone. Diopside occurs in small grains of microscopic size and is usually altered to chlorite; less frequently it is altered to zoisite as is seen on the southern slope of North Hill. Garnet which is in some cases distinctly birefringent, occurs either in small hypidiomorphic grains or in patches of larger sizes: they are usually plainly visible in hand specimens. The contact silicate rock shows different colors of dark green (due to diopside) varying to pinkish or brownish (due to garnet). When both of these minerals are present, a spotted appearance results. Cutting across the garnet or diopside marble are small veinlets of epidote, quartz and pyrite which form a later stage of mineralization, subsequent to the contact pyrometasomatism. In hand specimens, the epidote shows a grass-green color of vitreous luster, thus differing markedly from the dark or light green color of the chloritized rock. At Tsingshuitang, veinlets or radiating aggregates of zeolite, a blood-red mineral often closely associated with calcite, are found. According to Messrs. Meng and Chang there are five different varieties of zeolite with stilbite, of which the red-colored one is the most abundant. Cutting across the chloritized as well as the lead and zinc, ores are calcite and quartz veinlets which form therefore the latest stage of mineralization.

In conclusion, the successive events of rock alteration may be briefly enumerated as follows:

(*a*) Marmorization, garnetization, silicification and the formation of diopside. This represents the contact pyrometasomatic stage of the quartz monzonitic intrusion.

(*b*) Formation of epidote-pyrite-quartz veinlets. Nearly at the same time, some of the diopside was changed into chlorite and zoisite, while garnet was partly altered into chlorite. This represents the hydrothermal stage.

(*c*) Formation of zeolite (stilbite)-calcite veinlets. This represents most probably the later phase of the hydrothermal stage and should follow the sphalerite-galena formation, but conclusive evidence to support this assumption is still lacking.

(*d*) Formation of quartz and calcite veinlets which cut across the chloritized rocks as well as the lead-zinc ores.

The Ore Deposits

(*a*) *Mine working.*—The mine has at present one incline and one shaft called No. 1 and No. 2 respectively: besides, there are five native mines called Hsishou, Hsilu, Hsifu, Sinchung and Chengchichang. The No. 1 mine is an incline down to the third level of 145 m. in depth, below that a vertical blind shaft has been sunk down to the sixth level at 272 m. The No. 2 mine is a vertical shaft having a depth of 140 m. It connects the third level of the No. 1 incline. The Sinchung incline has a vertical depth of about 50 m. and is connected with the first level of the No. 2 mine. The other native mines have a depth of 30-40 m. only, being all above the first level of the No. 1 mine.

The total east-west extension of the underground working from Hsishou mine to No. 2 shaft is about 500 m. in which about 360 m. are mineralized. The principal ore bodies are concentrated in the eastern half of the mineralized belt, for a distance of about 180 m.

(*b*) *Occurrence*—The Shuikoushan lead-zinc deposits occur in various forms of veins, pockets or chambers which are usually too irregular and too complicated to permit accurate description. The pockets, etc., may send out off-shoots or branches, which after some distance may be separated or united again in a most anastomosing way. A general idea of the shape of the deposits may be gained from Fig. 2 which shows a longitudinal section of the Shuikoushan mine.

The irregular bodies of ores are called by the local miner "shahu" which means a pool of ore. The engineers of the mine have adopted a numbering system to name the different pockets, such as A1, B2, C3, etc. The alphabet refers to their position in the level, while the numbers indicate the different ore bodies; but in many cases these bodies are connected in a most complicated way, so that each number does not necessarily indicate a single ore pocket. Very frequently a single pocket or chamber may receive several numbers.

While the mineralized belt is confined chiefly to the contact line between the limestone and the quartz monzonite, the ore pockets are found already outside of the contact zone, being

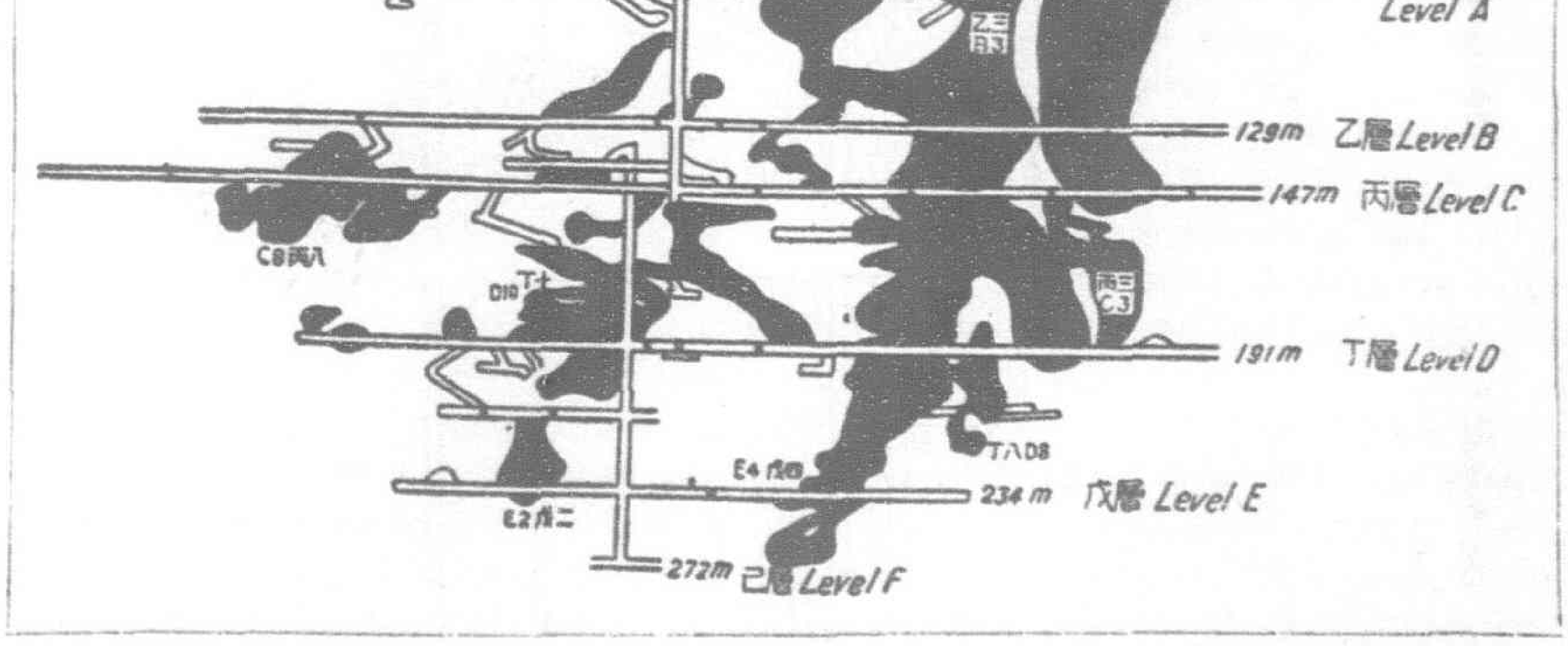
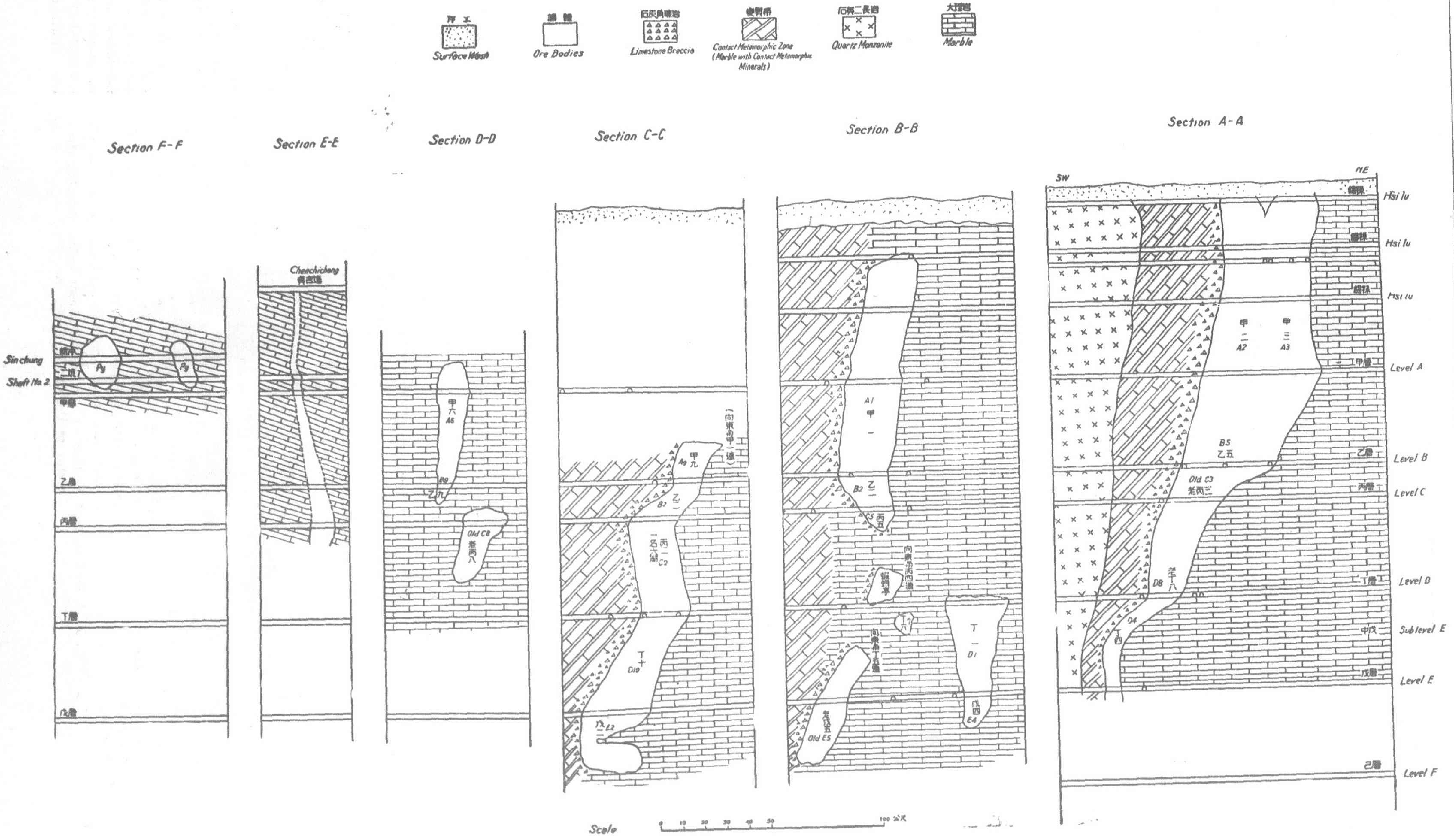


Fig. 2—A longitudinal section of the Shuikoushan mine showing the shape of the ore bodies

湖南水口山鉛鋅鑛床剖面圖



usually about 10 or 20 m. from it. The contact zone, marked here by a greenish or brownish colored diopside and garnet rock, contains as a rule no ores, except a few scattered disseminations. The principal ore bodies are found in white or gray marble in which contact silicate minerals are conspicuously absent.

TABLE 1—PARAGENESIS OF THE LEAD-ZINC DEPOSITS OF CENTRAL HUNAN (Hsieh and Cheng)

Minerals	Pyrometasomatic to hypothermal stage	Mesothermal stage	Supergene stage	Surface oxidation
Hematite &				——
Limonite				——
Carbonates, sulphates of Pb. Zn.				——
Malachite				——
Native copper			——	
Covellite			——	
Chalcocite			——	
Bornite		——		
Chalcopyrite (with tiny inclusions of Tennantite)		——		
Calcite-zeolite-quartz formation		——		
Galena with tiny inclusions of Tennantite		——		
Tennantite		——		
Sphalerite with Chalcopyrite inclusions		——		
Pyrite		——		
Specularite		——		
Epidote		——		
Chlorite		——		
Zoisite		——		
Diopside	——			
Grossularite	——			
Quartz	——			
Calcite	——			

(c) *The two mineralized belts*—In the vicinity of the Shuikoushan mine, two mineralized belts may be distinguished. The eastern belt which is now being exploited in the No. 1 mine and several other native mines, shows a north-west to south-east trend. It extends from the Hsishou mine in the east to the Hsifu mine in the west for a total length of about 300 m. Ore bodies are concentrated on the eastern half of the belt about 180 m., in which four groups of detached but more or less connected pockets of irregular outline are found. These pockets are usually of considerable size attaining as much as 50 m. in diameter and extending to the great depth of 270 m. They are continued further though at greatly reduced size. Further towards the west, as at the Hsifu mine, ore pockets are decreasing both in number and in size and become at the same time impoverished in quality. They extend to only about 100 m. in depth.

The different ore bodies of the eastern belt maintain usually a steep pitch towards the south or south-west, i.e., to the igneous side of the contact. This is shown by the fact that their positions are shifting more and more to the south when they are traced from an upper level to a lower one. The contact plane between the igneous rock and the limestone dips steeply in the same direction though it appears to be more nearly vertical, so that eventually there comes a point where the ore body will meet the igneous rock, and this very point will mark perhaps the theoretical limit of the vertical extension of the deposits.

As can be seen from the several transverse sections (Plate II) made across the ore body, the hanging wall is a metamorphic silicate zone which is usually bordered at its immediate contact with the ore by a breccia of varying width. This breccia, consisting of angular fragments of marble cemented by ores and silicate minerals, is evidently formed by the dissolution effect of the ascending magma as well as the mineralizing solution. Above the contact zone comes the igneous rock. The footwall is a white or gray marble free from any silicate minerals.

The western mineralized belt lies between Sinchung and Chengchichang with the No. 2 mine as the main exit. Here the contact of igneous rock and limestone trends in a north-east to south-west direction, along which the different ore pockets are distributed. It can be seen, therefore, that the trend of the western belt differs markedly from that of the eastern, one being diagonal with the other. The contact plane between the igneous rock and limestone dips also towards the igneous side, i.e., to the south-east. This is proved by the fact that limestones are extensively distributed in the underground of the Sinchung mine, where on the surface only igneous rocks are to be found.

The total length of the belt measures about 300 m. in which ore pockets are however, greatly reduced both in number and in size. They form usually narrow chimneys or pipes with little development of branchings or offshootings. The principal ore is pyrite with only few and small pockets of galena and sphalerite. As in the eastern belt the ore bodies are localized a little way outside of the contact zone, the latter consists as usual of garnet and diopside rock and is also bordered by an irregular rim of breccia on the ore side. The foot-walls of the ore bodies are also a pure and white marble usually coarsely grained; such laminated structure as is often seen on the eastern belt being conspicuously absent here.

(d) *Ore reserve*—The total reserve of the Shuikoushan deposits including lead, zinc and pyrite ores has been estimated by various authors to be about 2,000,000 tons. More than 1,500,000 tons of good lead and zinc ores have already been mined, so that there remains now only an inappreciable amount of ore composed probably mostly of pyrite.

(e) *Other mineralized belts*—Besides the principal ore bodies at the Shuikoushan mine, there are other mineralized belts, either not yet developed or at present of no economic importance. At Tsingshuitang, about one km. south-east of the Shuikoushan mine, former prospecting has revealed the presence of a contact zone of marble but no ore has yet been found owing perhaps to the inadequate amount of the prospecting work. At Lungwangshan, about 1½ km. south of the mine, a conspicuous outcrop of gossan and breccia long ago attracted the attention of the old miners. Tradition tells of the enormous amount of silver produced in old times. Remains of old pits and waste dumps can still be seen.

In fact, it was the development of the old prospects here, that has led to the discovery of the rich deposits at Shuikoushan. A tremendous amount of prospecting work was undertaken by the Shuikoushan mine during the years 1915-1916, but without any success. The ore so far found was pyrite occurring in siliceous shale. At Laohuyen, about one km. west of the mine, a great amount of pyrite had been turned out in former times. The work must have been very extensive, judged from the abundance of the old pits. At present, however, none of them are working. The pyrite smelters near by are using the ores from the Shuikoushan mine.

(f) *The ore minerals*—The principal ore minerals are pyrite, sphalerite and galena with sphalerite usually more predominating than galena. This feature is especially marked in the ores of the deeper level, where the present mining operations are chiefly confined. From hand specimens, it can be clearly seen that pyrite was formed first and then it was succeeded by sphalerite and galena. All these ore minerals are frequently traversed by veinlets of calcite and quartz. In some specimens a beautiful laminated and contorted structure is shown. These structures are believed to represent selective replacement of original laminations in limestone.

Besides the three principal ores just mentioned, there occurs also a small amount of tennantite, bornite, chalcopyrite, chalcocite, and covellite, named in their order of crystallization. The last two, i.e., chalcocite and covellite, are evidently of supergene origin, since they usually occur along cracks, or form little veinlets cutting across the other minerals. Tennantite, showing a light greenish tinge under vertical illumination, is in close association with galena as well as chalcopyrite, and is common in the ores of upper levels. While patches or fragments may be found, tennantite occurs most frequently as tiny grains or streaks in both galena and chalcopyrite. There are two generations of chalcopyrite. One forms tiny rods in sphalerite representing perhaps the product of unmixing, while the other occurs in irregular fragments usually on the border of galena and tennantite, and is distinctly of later origin. Bornite together with the supergene minerlization of chalcocite and covellite are closely associated with chalcopyrite and are only found in the upper parts of the ore body. A pyrite ore from Tsingshuitang excavation contains also a little bornite and chalcopyite. In the collection from the deeper levels all these copper minerals are only rarely represented.

The ore may be coarse-grained and with all its constituents clearly discernible, or it may be massive, compact and fine grained, composed apparently of one mineral only, like pyrite, galena, or sphalerite as the case may be. Under the microscope, it shows at once that such massive ore contains usually all these three minerals in a most intimate association.

Both galena and sphalerite are silver bearing. According to the report of the Shuikoushan Mining Administration, the galena concentrate contains on the average about 29-32 oz. of silver per ton, while the sphalerite ore contains about seven oz. per ton. Very likely the silver is derived from tennantite, a mineral usually considered as silver-bearing, and which is fairly abundant here in both galena and sphalerite.

At Tsingshuitang, specularite in radiating needles is seen to associate with epidote and to form veinlets cutting across garnetized and chloritized rocks.

(*g*) *Sequence of deposition*—When both the gangue and the ores are considered together, their successive stages of formation, in other words, the paragenesis of the deposits may be traced. For simplicity sake, they are summarized in Table 1.

Conclusion

The Shuikoushan Mining Administration has undertaken during the last twenty years extensive prospecting work with a view to find new ore bodies. Shafts and inclines have been opened up at incline No. 2, Sinchung, Tsingshuitang, and Lungwangshan. The results so far obtained have been either unsatisfactory or the work was only half done as in the case of Tsingshuitang, so that final conclusions cannot be drawn.

A number of prospecting drifts have been driven in the underground of the No. 1 mine, but none of them has yielded any ore bodies of appreciable size. The drifts are directed either to the north or to the south. The southward-directed drifts which have penetrated as far into the igneous rocks as 100 or 200 m. were evidently carelessly laid without any geological reasoning. Among the drifts directed towards the north, there are some of considerable length measuring 300-400 m. They have reached nearly to such places as on the surface are marked by the railway station or North Hill. The laying of such north-directed drifts is not without reason, since in case the igneous mass should have bulged up in the north, there might be produced another zone of contact metamorphism and consequently a mineralized belt. The failure to find ore in this direction proves that the above theoretical consideration does not hold.

Beyond North Hill the surface is occupied by chert beds of Permian age which limits the northern extension of the limestone. Since the latter is the sole-bearing formation in the Shuikoushan district, the existence of any ore further towards the north is consequently improbable.

CHANGING SIAM

(Continued from page 11)

foreigners in Bangkok pursued their avocations undisturbed and held their customary social functions, but there were at first many complaints of a slackening of trade on account of doubt as to the stability of the new regime.

An attempt, fortunately unsuccessful, on the life of the Minister of Defence, Luang Bipul Songgram, and an abortive conspiracy which had for its object the assassination of members of the Government and prominent officials, darkened the horizon for a time, but by the spring of 1936, after the remodelling of the State Council, again under the Premiership of Colonel Phya Bahol, the atmosphere seemed to have cleared and public confidence was in process of being restored.

Two things in Siam are of particular interest to the student of politics.

The first is the slow but steady penetration of the country by the Chinese. The Western movement of population from China which, through a long period of years, has set like a tidal current on the coast of Malaya, and which finally expends itself in the backwaters of Siam, is comparable in effect with the more spectacular migrations of the Thais from Southern China which began 2,000 years ago. Already there have been results of great importance from the ethnological, commercial, and sociological points of view, but these cannot be described within the limits of a short article.

The second point is the effect produced upon Siam's relations with foreign powers by the nationalistic developments of the past few years.

The Siamese have always acknowledged with courteous gratitude the advantages that they have reaped from the assistance and tutelage of Western Powers. At the same time, they have been well aware that the benevolence of foreign nations could not be wholly untinged with self-interest, while the entertainment of foreign advisers proved sometimes an expensive method of acquiring experience. One of the foremost ambitions of the new State Council has naturally been to free Siam from any semblance of domination by foreign interests. A Government which can demonstrate to the people that its regime has improved the country's status among the nations is likely to reap a harvest of enthusiastic support, and thus incidentally to ensure its own continuity. This it must naturally believe to be of the highest importance to the salvation of the country.

Again, there may be commercial profit or other aggrandisement to be gained by diplomatic adventure in paths which were not frequented by those who were formerly responsible for Siam's foreign policy.

It was not to be expected that Siam's foreign relationships would remain, after the *coup d'état,* upon precisely the same footing as they were before. But whatever new friendships may be cultivated and whatever new obligations may be undertaken, it may be regarded as certain that the leaders of the People's Party which is now controlling the destinies of the country will never desire, by any action of theirs, to loosen the ties which have united Siam and Great Britain in interest and affection for so many years past.

I once heard a Siamese gentleman say: "Of course English is our second language," and by many Siamese England is undoubtedly regarded as their second home, while in matters of international moment there is a solidarity of thought and a community of interest which make for harmony of action. English people who live for any considerable period of time in Siam find themselves greatly attracted by the unique charm of the country and entertain a very real and lasting affection for the many friends they make there.

The Englishman feels more quickly at home in Siam than in any other Eastern country, because he soon realizes that in the present-day representative of the Thai race, of both sexes, he will find true comrades who will share all his amusements and interests, whether in sport or in the serious affairs of life, and will gain his respect and affection by their dignity and amiable courtesy, and by the many remarkable talents which they possess.

Vast Extensions at Witton Made by The General Electric Company

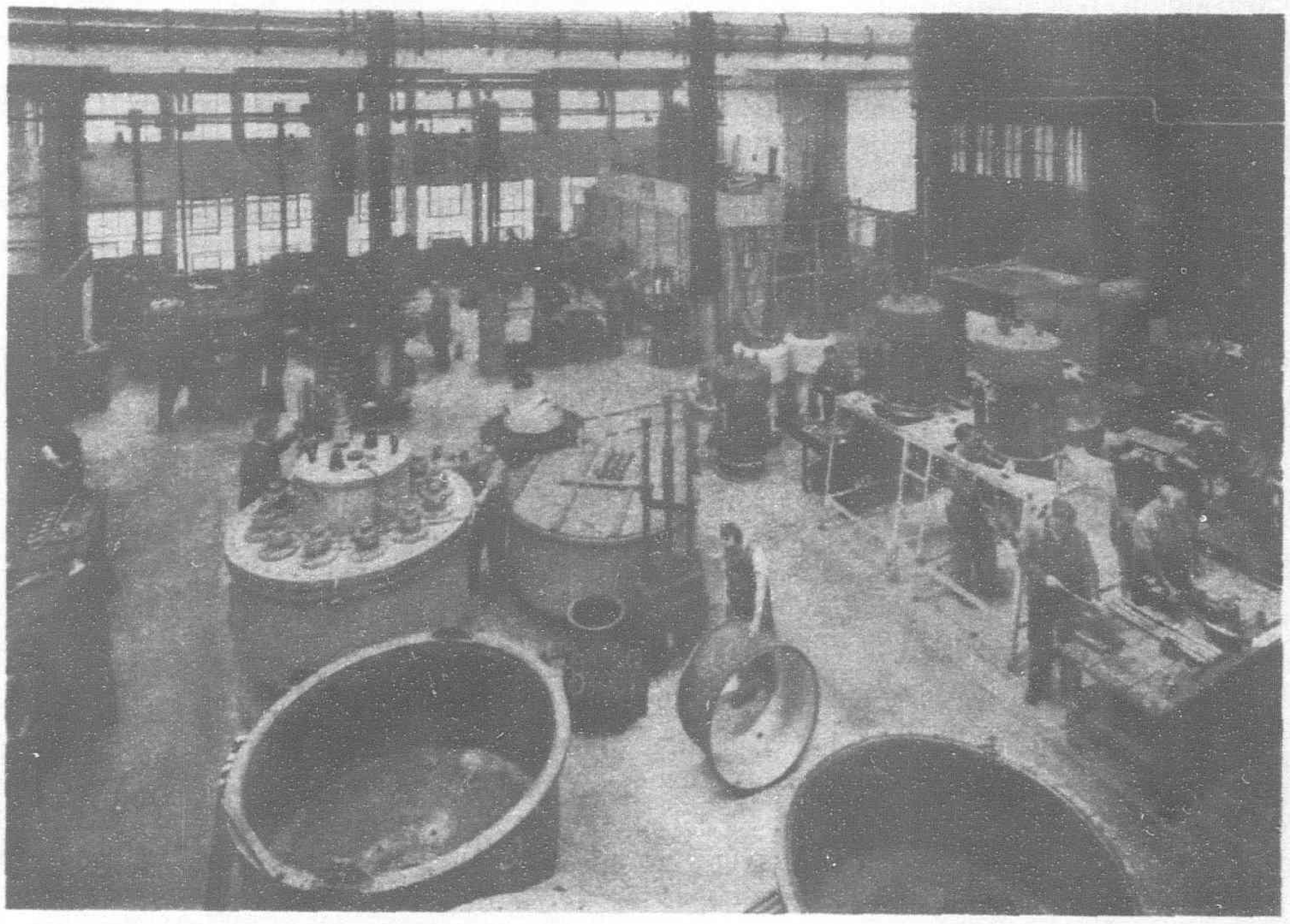
(A representative of The Far Eastern Review was a member of a party of representatives of leading engineering journals in England that visited and inspected the great engineering works of The General Electric Company at Witton in November. An indication of the growth and the extent of this huge enterprise is to be gathered from the following article).

* * *

PRODUCTION was started at the Witton Works of The General Electric Co., Ltd., early in 1902, when in a small group of factories of modest dimensions manufacturing D.C. motors and generators, electric light carbons and conduit formed the principal ranges of manufacture.

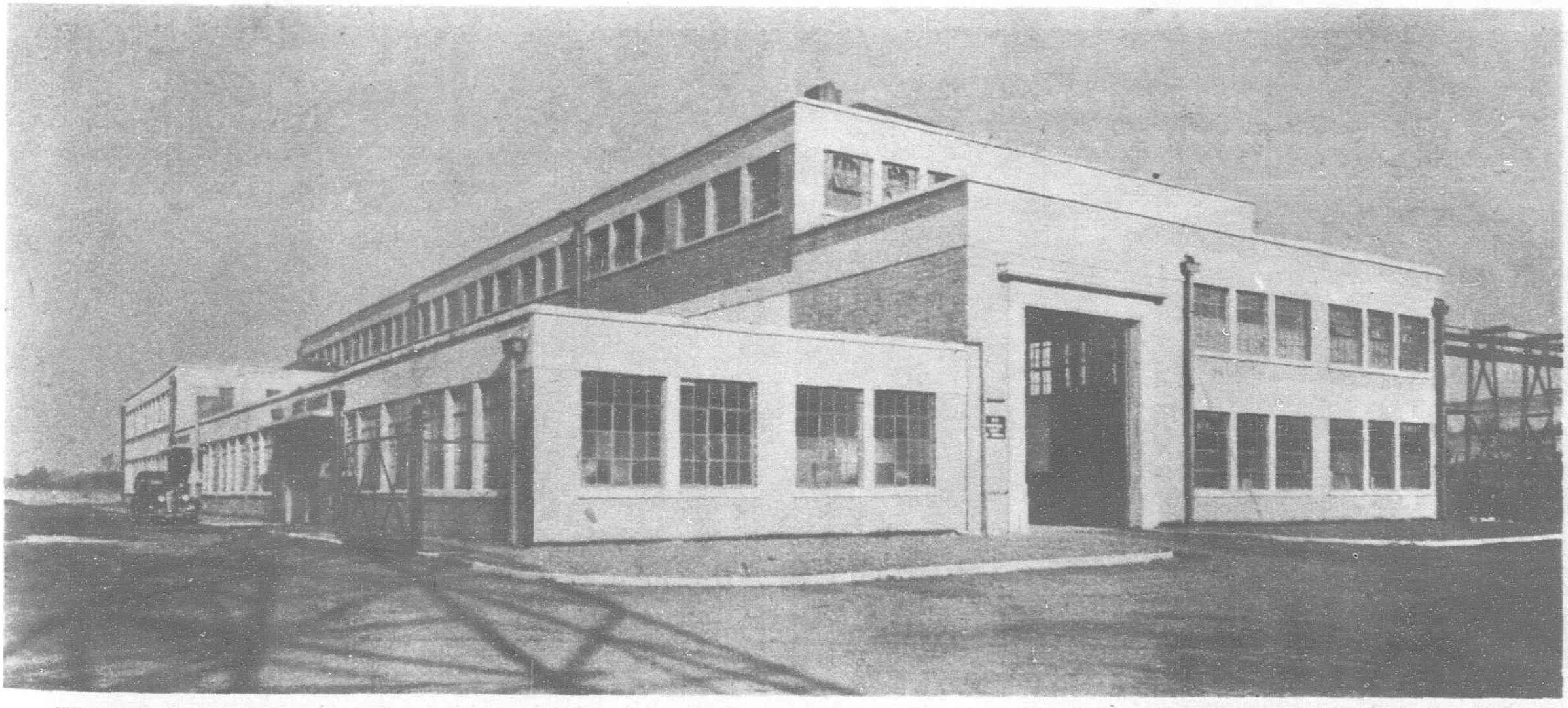
Since then extensions and development have proceeded continually until to-day the G.E.C. manufacturing organization at Witton is one of the world's most prominent centers of electrical production. Its output includes the largest units of plant required in modern industry, extra high tension switchgear, marine electric propulsion equipment, traction equipment, rolling mill motors, colliery winder motors, and an enormous range of specialized apparatus, the scope of which may be judged from the following list of works, laboratories and other principal departmental buildings which have been erected on the 200-acre Witton site :—

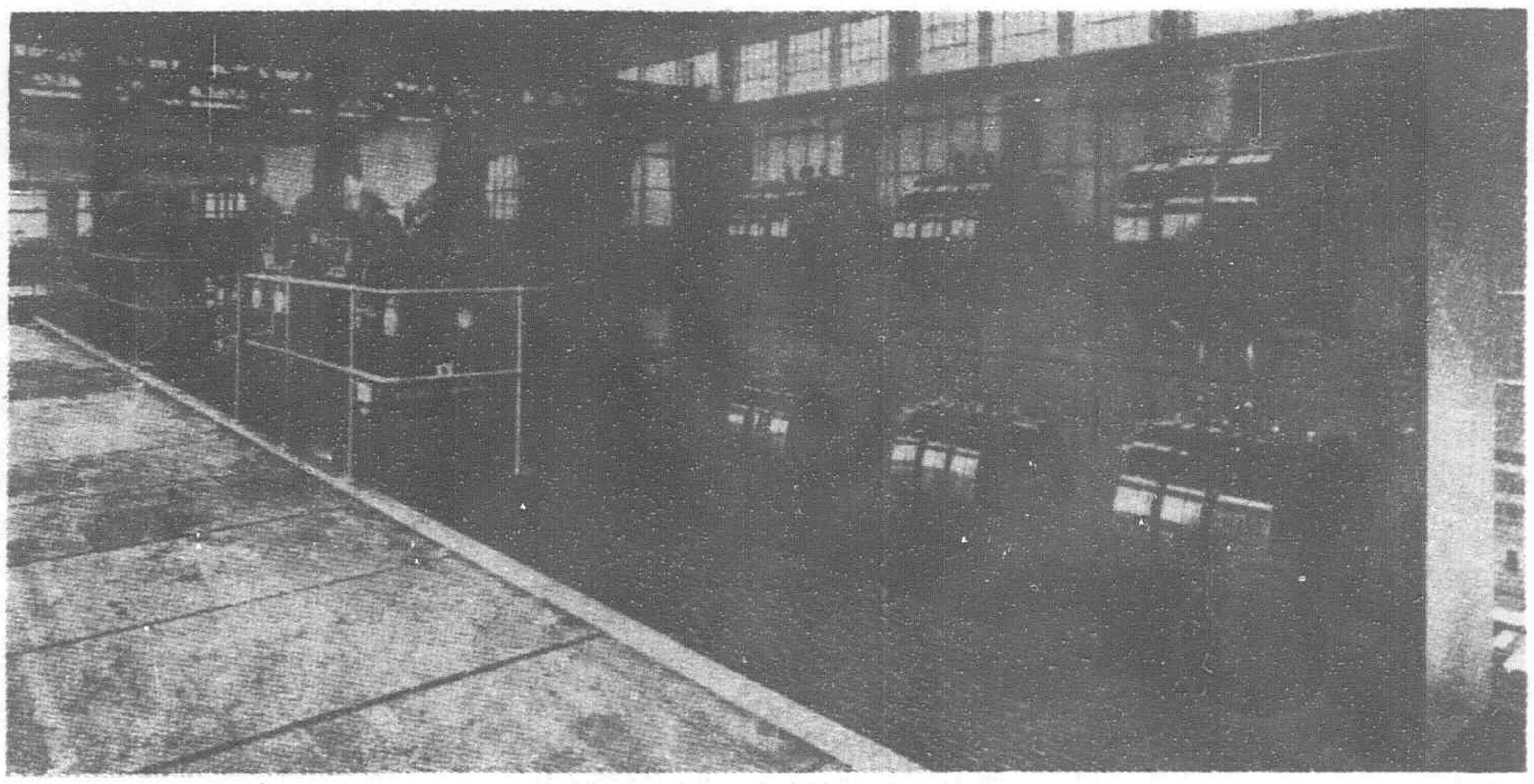
Main Engineering Works
Mercury Arc Rectifier Works
Transformer Works
Standard Motor Works
Small Motor Works
Fan Works
Motor-driven Domestic Appliance Works
Tool and Hoist Works
Mica Shop
Foundry
Power House
Main Test House
Central Stores
Main Switchgear Works
High Tension Switchgear Works
Standard Starter and Controller Works
Ironclad Switchgear Works
Carbon Works
Battery Works
Lamp Black Works
Moulded Insulation Works
Plating and Enamelling Shops
Development Department
High Power Test
High Tension Test
Main Administration Offices


The assembly bay of the new G.E.C. mercury arc rectifier works

The Witton site was purchased by the G.E.C. chiefly in order to provide for the erection and development of heavy engineering works which would be able progressively to meet the demand for the largest units of electric power plant. A further object was the establishment of other groups of works, each capable of undertaking specialized production of some particular branch of electrical manufacture.

Originally, in 1902, Witton Works consisted of engineering works, carbon works and conduit works, together with a foundry and test house. By 1914 facilities for the erection of heavy plant


The new G.E.C. mercury arc rectifier works built for the manufacture of both pumpless, air-cooled steelclad rectifiers and water-cooled rectifiers. This is the first self-contained steelclad mercury arc rectifier works to be built in the world



Change-over switchboard for testing

had been greatly increased, due partly to extensions to the engineering works, and also because the smaller machines were no longer made in this works, a new specialized works having been erected for their production. Other extensions which had been completed were devoted to switchgear and arc lamps. Upon the outbreak of war the carbon works was greatly enlarged to meet the national emergency, but from 1914 to 1918 practically no further extension was possible.

Shortly after the declaration of peace the G.E.C. embarked upon a scheme of great magnitude, and within two or three years there had been erected at Witton three entirely new works, namely, a main switchgear works, a standard motor works and a moulded insulation works. In addition, two new blocks of buildings housed respectively the administration departments and the development department, while considerable extensions were made to the foundry, small motor works and main engineering works. This last extension was of the utmost significance, for it was equipped for the specialized production of turbo-alternators and, by the removal of the production of both turbo-alternators and standard industrial motors from the main engineering works, greatly increased floor space was made available for large electrical machinery other than that of the turbo type. Briefly, within a few years manufacturing resources had been doubled, and Witton stood in the front rank of world manufacture of the heaviest electrical plant.

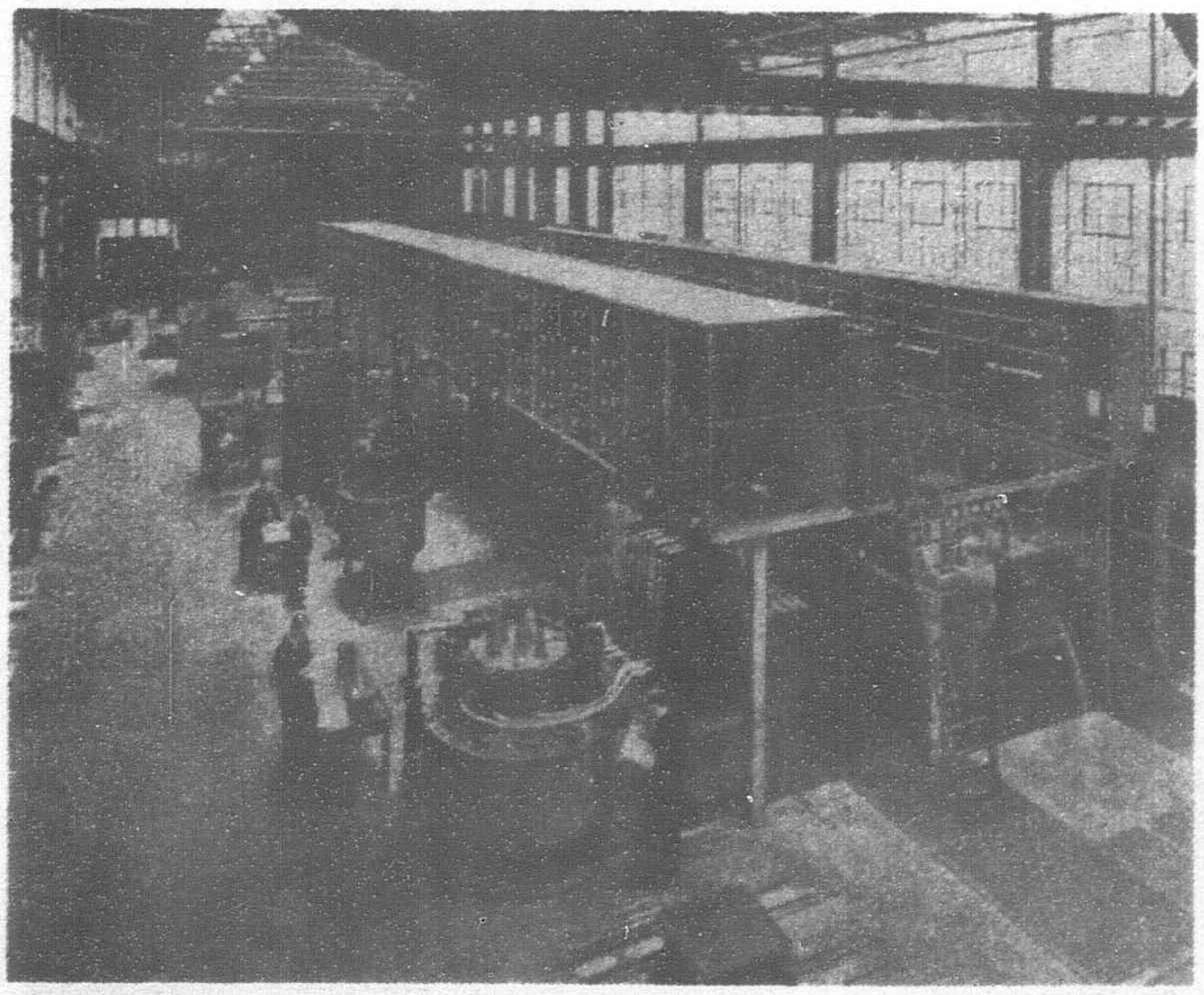
The Electricity Supply Act of 1926 soon led to plans for the British Grid, and in anticipation of the demand for extra high tension transmission and distribution equipment yet another extensive works was built. It contained the most modern equipment for the manufacture of high tension switchgear up to 220,000-volts and 100,000 kva transformers up to 132,000-volts, and in addition a high tension testing laboratory in which tests could be made at voltages up to 1,000,000-volts.

Even during the days of the economic depression, felt so severely during 1931-2, the G.E.C. had the faith to launch new enterprises, and the building of a vast new central stores and also a new works for battery production was undertaken.

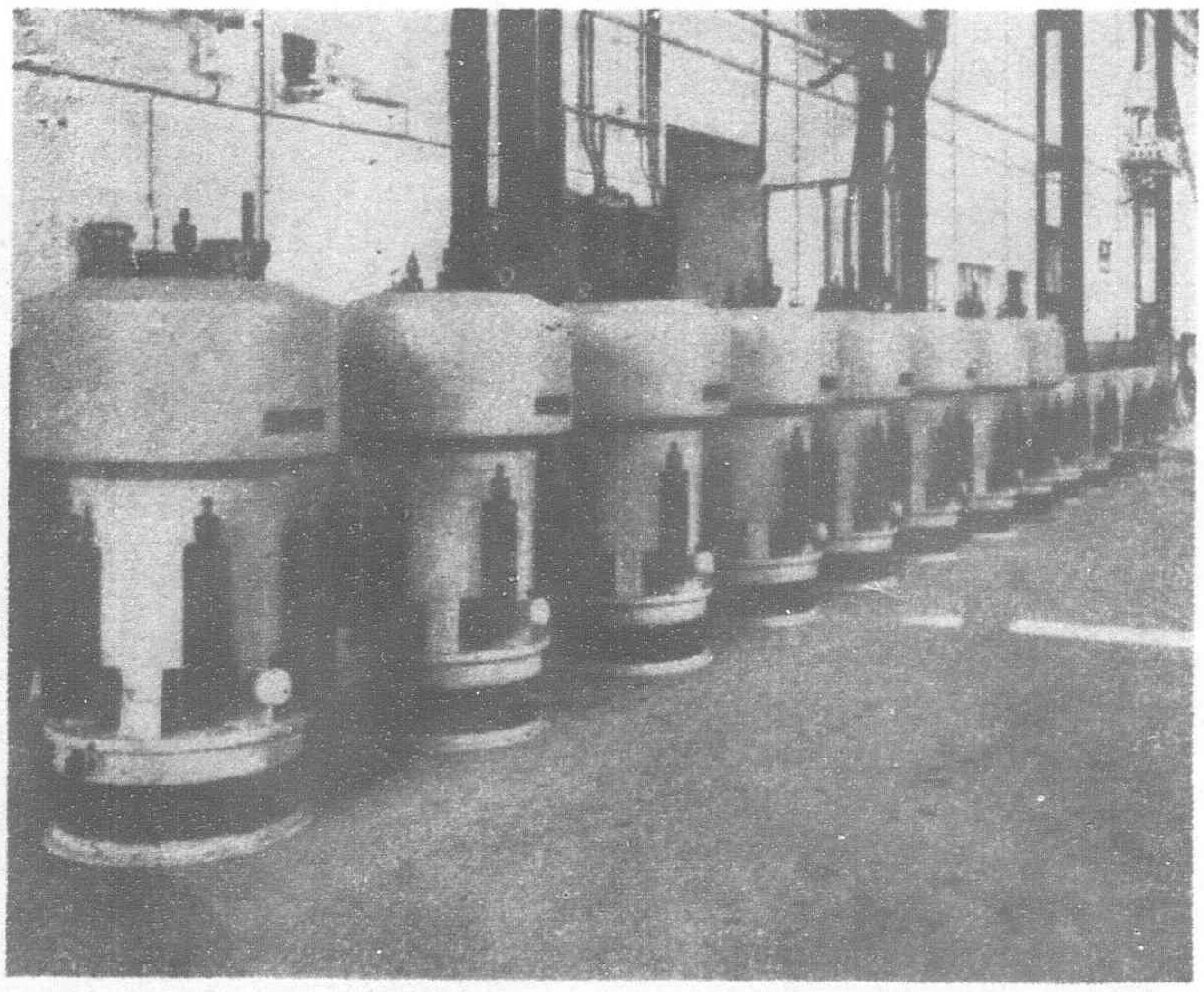
With the improvement of trade conditions in the last few years yet another big move forward has been witnessed, and the latest additions on the Witton site include a high power testing laboratory, mercury arc rectifier works, starter and controller works, motor-driven domestic appliance works and mechanized foundry; moreover, a spacious two-storey finishing factory forms an extension to the moulded insulation works, and a new winding bay having an area of over 20,000 sq. ft. has been added to the main engineering works, thus again increasing the space reserved for the manufacture of heavy plant. Finally, both the new central stores and battery works—referred to in the preceding paragraph—have been greatly extended. For the second time within a short span of years the manufacturing resources of Witton have been doubled, and the floor space area now available for manufacture, development activities and administrative purposes amounts to 70 acres.

New Manufacturing Resources

One of the latest and most important additions to Witton is the new Steelclad Mercury Arc Rectifier Works. This is an entirely separate building, and special interest attaches to the fact that it is the first self-contained works to be erected in the world for the production of steelclad mercury arc rectifiers. It is in these new works that the pumpless air-cooled steelclad mercury arc rectifier—the development of which is regarded as one of the most outstanding achievements of the G.E.C.—is manufactured in its commercial form. A typical installation of this type of rectifier is two 500 kw. 600-volt D.C. twin cylinder rectifiers installed in the Hammersmith substation of London Transport. A total of 23 similar cylinders are now operating on the Board's system, and many similar units are being installed in all parts of the world. Water-cooled steelclad rectifiers are also made in these new works, and all the necessary plant is installed for the production and testing of both types of rectifier.



Test bay of the mercury arc rectifier works, showing the two switchgear galleries, that on the left comprising the anode bus-bar cubicles; testing transformers are underneath



A group of pumpless air-cooled steelclad mercury arc rectifiers destined for service with London Transport and for export to Melbourne, Athens and Canton

The pumpless air-cooled steelclad rectifier is manufactured in sizes corresponding to a current range of 350 to 750 amperes for voltages up to 800. For voltages of 1,500 and 3,000 rectifiers up to 1,000 kw. can be produced as single units. Larger sizes are in course of development. A range of 6 and 12-anode water-cooled rectifiers is manufactured for load currents of 1,000 amperes and upwards capable of meeting all the usual commercial requirements up to working pressures of 4,000-volts.

The new works, which covers an area of 20,000 sq. ft., is built on a part of the Witton estate where there is ample room for future extensions. The building runs approximately north and south, and comprises, briefly, a receiving stores, machine tool and assembly bays, an exceptionally comprehensive testing plant, dispatch department, and a substation supplying the works with power. There are also a number of auxiliary shops and offices.

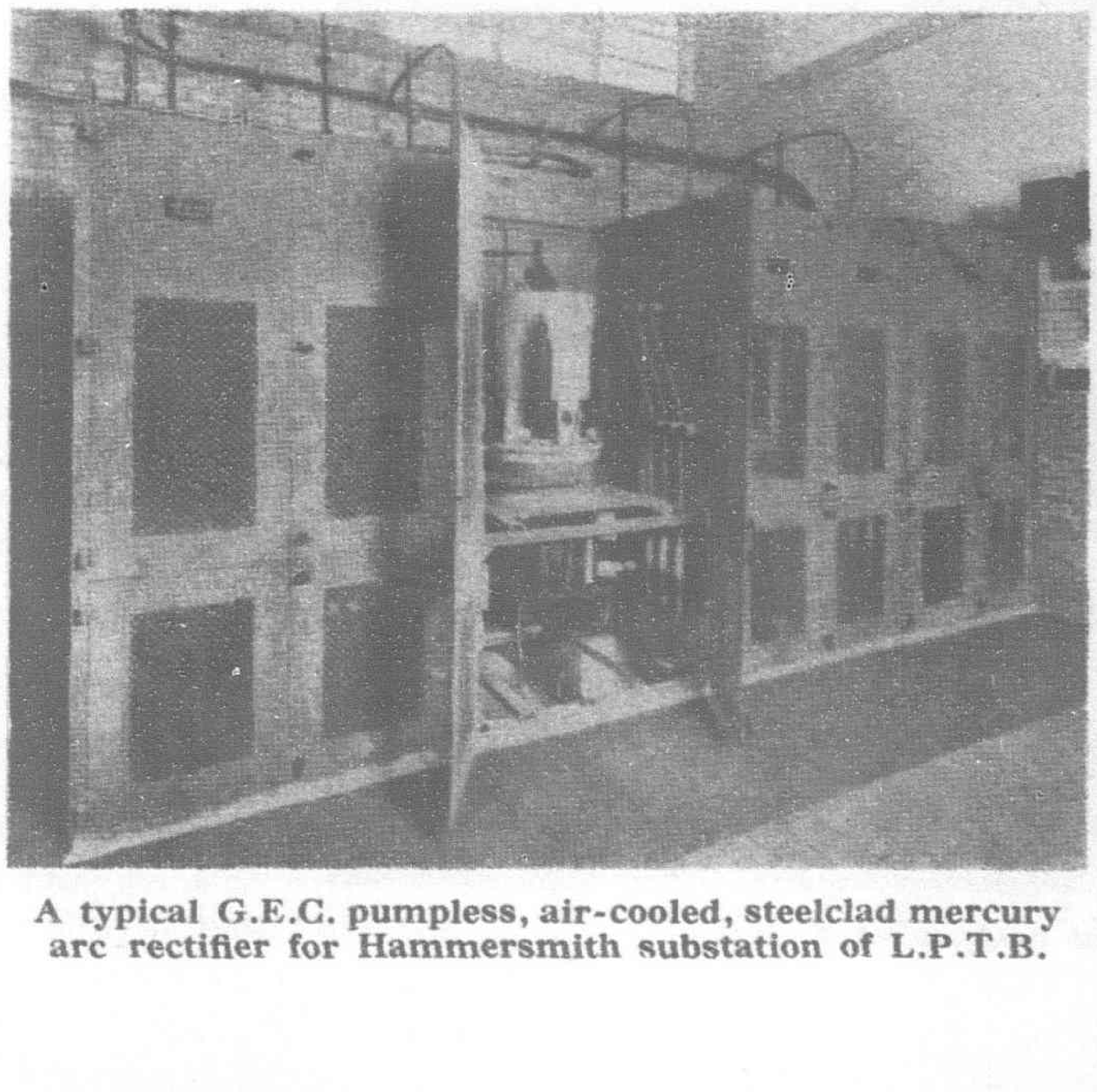
Two test bays of high power test laboratory at Witton. The large oil circuit breaker on left is 11 kv-1,000,000 kva

Along the south-west side of the building are situated the administration and drawing offices and various shops for process work, while skirting the north and east sides of the assembly bay are further shops for mercury filling, leakage testing, fitting, oxyacetylene and electric welding, paint spraying and shot blasting. The works is provided with two 15-ton cranes which operate along its entire length, i.e., from receiving end to dispatch end.

Practically the whole of the manufacturing work required for the production, testing and dispatch of mercury arc rectifiers is carried out in these works, the only exceptions being the production of castings and the larger sizes of tanks used for water-cooled rectifiers. The raw material is received at the stores entrance at the north end of the building, and is taken, as required, from the stores into the machine tool and assembly shops. The tanks for the small and medium size rectifiers are welded from sheet steel and then thoroughly scaled and cleaned in a large shot blasting plant, which consists of a large metal chamber capable of housing the largest rectifier tank.

The vacuum seals for the anodes of the rectifiers, which are of particularly interesting construction and are the subject of important G.E.C. patents, are made in a separate shop adjoining the assembly bay. The design of these seals is of a unique character, and their development has made possible the introduction of the G.E.C. pumpless air-cooled steelclad rectifier.

The rectifiers are partly assembled on special jigs and are then taken into a dust-proof mercury filling room. The cleanliness of this room and the special ventilating system installed enable the final stages of the assembly of the rectifier to be undertaken in a dust-free atmosphere, while the methods employed of handling the mercury ensure the maximum possible degree of safety for the workmen. The anodes, which are made in a separate dust-proof shop, are assembled with the remainder of the rectifier in the mercury filling room.



A typical G.E.C. pumpless, air-cooled, steelclad mercury arc rectifier for Hammersmith substation of L.P.T.B.

The testing of mercury arc rectifiers is of such importance that a large proportion of the new works is occupied solely by testing plant. The Company has long realized that the foundation on which the successful operation of its products is based is the thorough testing they receive. The testing plant installed in the new works is therefore of a particularly comprehensive nature.

The size and layout of the test plant were governed by the following most important considerations :—

(1) The plant should have sufficient kw. capacity to enable the largest units to be tested at loads well in excess of likely service conditions, both as regards current and voltage.

(2) The plant should be subdivided so that development work at heavy outputs can proceed uninterruptedly at the same time as routine production testing.

(3) The layout should be such as to enable the rapid and safe change-over of the connections.

The plant installed to meet these requirements includes two large motor-generator sets, each consisting of a synchronous machine directly coupled to two D.C. machines and a variable speed driving motor. The two sets may be operated entirely independently of each other or electrically coupled together, and in the latter case the four D.C. machines may conveniently be interconnected so that a continuous output of 6,000 kw. is obtainable at 900, 1,800 or 3,600-volts.

Three large rectifier transformers are provided, having a total capacity of 16,500 kva. The largest single unit, which is rated at 9,000 kva, is suitable for testing 900, 1,800 or 3,600-volt rectifiers and inverters at full capacity, and may be connected either " fork " or double three-phase, a separate interphase transformer being provided for use with the latter connection.

In addition to a number of equipments for the treatment of air-cooled pumpless rectifiers, the plant includes two heavy-current low voltage transformers together with variable resistance loads and switchgear for the de-gassing of large rectifiers.

One prominent feature of the plant is the two switchgear galleries, each of which extends practically the whole length of the test room. On one of these is mounted a switchboard whereby the primary of any transformer may be fed from any available supply. On the second gallery are a total of forty-eight 1,250-ampere bus-bars and jumper connections by means of which the anode terminals of any transformer may be connected to any test bed, thus economizing in time and eliminating temporary wiring when changing from the de-gassing to the testing equipments. All switches, cubicles and the like are interlocked to prevent danger of electric shocks and arcs.

So far as miscellaneous plant is concerned small motor generator sets are provided for auxiliary purposes and a system of high and low vacuum pipes serves the whole test room. One test bed is equipped with a large heat insulated enclosure wherein the ambient temperature may be controlled over a wide range.

When testing rectifiers the synchronous machines operate as alternators, energizing the primary windings of the rectifier transformer which feeds the rectifier undergoing test. The D.C. output of the rectifier is fed back to the D.C. machines, thus circulating the bulk of the power, whilst the driving motor compensates for the losses of the entire system.

Inverters are tested in a similar manner, but in this case the synchronous machines operate as motors and the D.C. machines as generators.

By means of an arrangement wherein alternate anodes are energized by a rectifier transformer and the remainder by a low voltage heavy current transformer, a 12-anode rectifier may be tested at continuous outputs up to 12,000 kw. or two units tested independently at half this value.

Power for the test plant is obtained from the works' substation, which takes an 11 kv supply from the municipal mains. The substation contains a cubicle switchboard and controls the incoming supply. Two mercury arc rectifiers are also installed, one of which is water-cooled and provides a D.C. supply for the testing plant, while the other is air-cooled and gives a D.C. supply to the works.

Adjacent to the test bay is the dispatch department, which opens out on to one of the main roads of the works estate.

The finishing shop of the moulded insulation works

High Power Testing Laboratory

Reference has already been made to the importance attached by the G.E.C. to testing. In this respect Witton Engineering Works is no exception. There are a number of such departments associated with the various individual shops, occupying quite a considerable proportion of the total area of the works and containing modern plant for the testing of the many varied products of the works.

One type of test, however, has always presented serious difficulties, that upon large circuit breakers. It would be difficult to find an electrical product that should be more fully tested and guaranteed than a circuit breaker, which is expected to prove reliable when other components have failed. To be effective, a test on a circuit breaker must reproduce the effects of the severest short circuit which it may be called upon to clear in service, necessitating the provision in the laboratory of an enormous amount of electrical energy, effective counter-measures against danger to life and equipment, and elaborate measuring apparatus.

It was, therefore, decided to build such a laboratory at Witton to satisfy these requirements, and the new laboratory thus constitutes a most important addition to the facilities of the works.

The laboratory is designed to produce an instantaneous three-phase short circuit of up to 2,000,000 kva, capable of testing circuit breakers up to one-and-a-half million kva at voltages ranging from 6.6 kv to 132 kv. Somewhat lower capacities can be obtained at voltages down to 400 and 230 by means of field regulation or a step-down transformer. These provisions cover all the standard requirements of power supply to-day, but the laboratory is laid out in such a way as to facilitate any future extensions that may be necessary, for example, as regards short circuit capacity, voltage, or volume of work.

Taken in order, the equipment of the laboratory comprises (1) generating equipment of the necessary large short circuit capacity and transformers for giving various voltages—illustrations of the generator and transformers are shown ; (2) apparatus for regulating the magnitude and power factor of the short circuit applied to the circuit breaker under test ; (3) separate switches for throwing on the short circuit and for removing it ; (4) special cubicles enclosing the circuit breakers to be tested and (5) a comprehensive installation of recording apparatus.

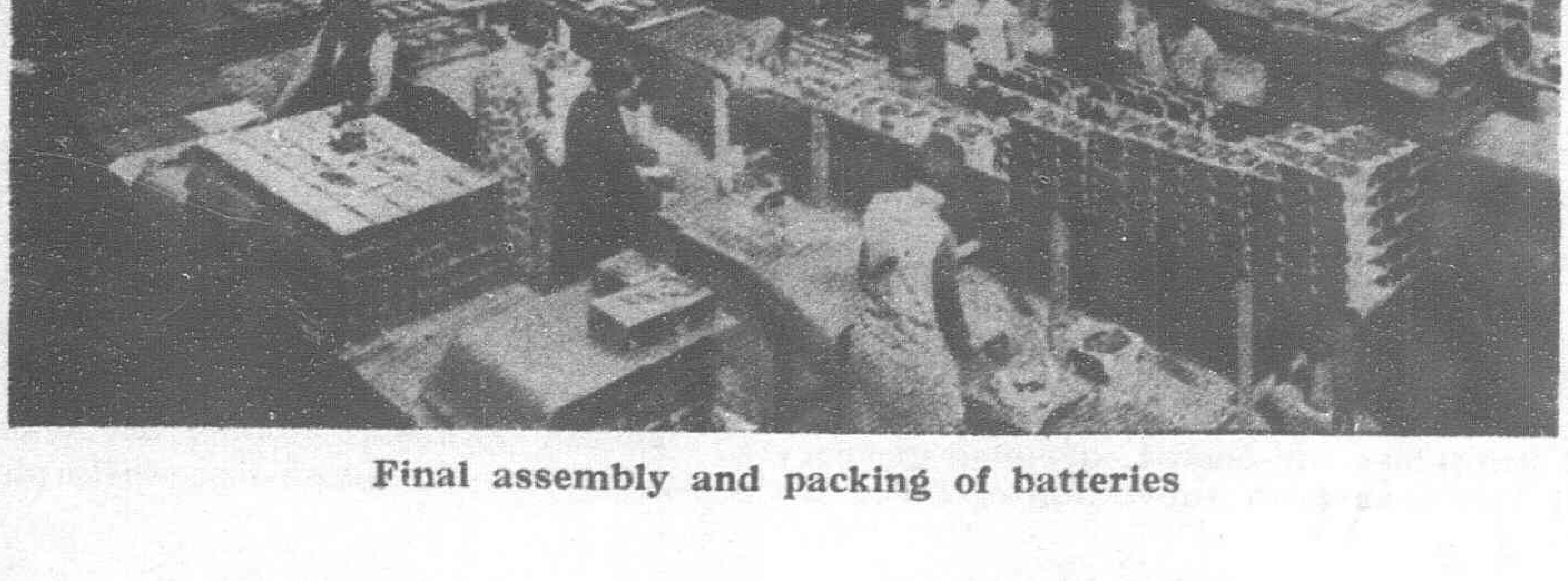
The main generator, fig. 8, has a normal rating of 50,000 kva and a reactance of 2.7 per cent. It is capable of giving a maximum symmetrical short circuit of 1,850,000 kva or an asymmetrical short circuit of well over 2,000,000 kva. This output is more than sufficient to test the largest circuit breakers manufactured in this country, and it is of interest to record that many of the largest breakers installed in the British Isles (such as the 132,000-volt, 1,500,000 kva outdoor breakers for the British Grid and the 11,000-volt, 1,500,000 kva metalclad breakers for Sheffield Corporation) were tested to their full capacity in this laboratory.

Battery Works

The manufacture of batteries has long been an important activity of the G.E.C. For many years they were manufactured in a group of shops situated in the carbon works at Witton, but the demand for G.E.C. batteries increased to such an extent that the then existing facilities for production became totally inadequate, and in 1933 one of the most up-to-date works in the country was put into operation for the production of wireless, flash-lamp and torch batteries. The new works was an immediate success, and before long it was meeting a demand in excess of its estimated capacity. The continued growth of this demand, however, necessitated extensions to the new building, and in 1934 the manufacturing space, which was then 45,000 sq. ft., was practically doubled. The output of battery cells from this works is enormous and reaches millions of cells per week.

The layout of the factory is on the most modern lines. Large shops, good ventilation and lighting, and adequate heating afford ideal working conditions for the employees. Illustrations showing interior views of the works and some of the processes are illustrated herewith. The raw materials are received at one end of the building, whence they pass through a number of fascinating processes, executed by the most ingenious automatic machinery, the finished product, in the form of a battery, being delivered at the far end of the factory ready for packing and dispatch.

In addition to the manufacture of wireless and torch batteries, the new works now also produces Leclanché cells for the G.P.O. and other Government Departments and batteries for colliery, signalling bells, telephones and the like, while a separate department produces the cardboard boxes and cases used for all G.E.C. batteries.



Final assembly and packing of batteries

The Mechanized Foundry

The foundry at Witton is well known as being one of the largest in the Midlands owned by a manufacturing organization. It covers an area of approximately $2\frac{1}{2}$ acres, and its flexibility is indicated by the fact that it produces castings weighing from $1\frac{1}{2}$ oz. to 25

Photo by Courtesy of The General Electric Co., Ltd.

A total of 96 ring spinning frames in the Lun Chong Cotton Mill, Shanghai, each driven by a 9-h.p. 1,440 r.p.m. G.E.C. squirrel cage cowl-cooled motor

tons. Quite recently a large extension was made to the old foundry by the addition of a large building constructed to house a new mechanized plant. This plant produces castings weighing up to 40 lb., using moulding boxes measuring 24-in. by 18-in. by 7-in. high. This size enables a varied range of castings to be manufactured such as ironclad switch cases, fractional horse-power motor shells, and bearing brackets for motors up to 5 h.p. Fettling and dressing operations are conveniently situated near the "knock-out" stations, while a totally enclosed sand-blast apparatus fed by a steel slab conveyor completes a compact installation affording rapid and orderly production.

The whole of the plant is housed in a spacious building having a roof which is so trussed that no floor pillars are necessary to support it, a feature which provided complete freedom for the layout of the plant. The spaciousness thus obtained is apparent in the general illustrations of the mechanized foundry.

The plant provides a good example of the lines upon which the old craft of ironfounding is being modernized. Rapid production of uniform castings is essential to keep pace with automatic machining processes, and while much scepticism has been expressed in the past as to the advantages of mechanization there is no doubt that complete success has been obtained and that mechanization has come to stay. Improvements are, of course, being embodied continually, and casting tolerances are being reduced to fine limits, calling for extreme accuracy in metal pattern making.

The equipment installed consists of two separate units, each comprising five pairs of moulding machines with ten sand hoppers (one over each machine), mould conveyor, knock-out station and sand preparation plant. Knock-out sand is passed over a magnetic pulley into the boot of a bucket elevator, which takes it straight up to a storage hopper near the roof. From this hopper the sand falls on to a rotary feed table, which controls the amount of sand passing out, and thence the sand passes to a vibrating screen which removes all hard burnt sand and cores. The screened sand then falls into a puddle mixer provided with a controlled water supply. The mixer discharges the sand on to a traverse belt, which conveys it across to a revivifier mounted at one end of a steel slab conveyor. The slab conveyor travels across the sand hoppers above the moulding machines and keeps them filled with sand. Any overflow of sand is passed down a chute at the other end of the plant on to a belt conveyor, which travels underneath the floor to the knock-out station passing under grids at ground floor level between each pair of moulding machines. These grids collect all surplus moulding sand and spillage from the moulders and the conveyor takes it to the knock-out station where it is mixed with the knock-out sand. The whole cycle of operations is then repeated.

A sand mill can be placed in circuit for milling any added sand or overshot hopper sand. Alternatively, the mill can be used as a separate unit for milling facing sand. By closing the gates above the hoppers all the sand, other than that lying in the hoppers, can be passed through the mill. This, however, has not been found necessary since the first few weeks after starting up the plant.

Casting is done on that part of the mould conveyor adjacent to the cupolas, which are placed at the side of the building furthest from the knock-out station. The moulding boxes are returned to the moulding machines on a gravity conveyor. It has not been found expedient to replace them on the mould conveyor, which is, therefore, kept clear for the reception of completed moulds from the machines.

The knock-out castings are placed in steel receptacles, which are transported to the tumbler barrels or the fettlers' benches. Immediately behind the knock-out stations is a slab conveyor, on which castings can be taken to a sand-blast plant. Grinding wheels, with underground dust extracting channels, are conveniently placed near the fettlers' benches.

All the small sea-sand cores are made by girl core-makers who work in the same building alongside one of the moulding units. The cores are dried in a continuous dryer, and afterwards placed on racks ready for the moulders. The sea sand is prepared in a Rotoil mixer and arrangements are provided nearby for drying the sand.

A concrete floored gallery supported from the roof runs right round the building. Patterns which are not in immediate use are stored in racks in this gallery. Racks are also placed in the gangway between the two units on the ground floor.

Moulded Insulation Works

The history of the Moulded Insulation Works at Witton has been one of continual expansion. From being little more than a small shed housing a few mixing machines and presses and employing a handful of people it has grown, within the span of 20 years, into the largest plastics moulding works in the country, providing work for over 1,000 employees, and manufacturing a wide range of moulded products, including lamp holders, switches, adaptors, plugs and—more recently—bakelite fires and heaters.

At the time when plastics moulding was started at Witton the plastics industry was in its infancy, and the bulk of the products were made from natural resins, rubber and bitumens with the incorporation of suitable fillers to meet individual requirements. The introduction of raw materials such as bakelite, followed by urea, synthetic resins and cellulose acetate, gave the industry a considerably greater importance which was reflected at Witton by the building of an entirely self-contained works.

From time to time these works were extended: more space was required for the larger presses employed; a separate department was built for the production of accummulator battery containers; additions were made to the finishing and assembly shops. As time passed the number and size of the new extensions increased. In the years 1933 to 1935 over 25,000 sq. ft. of manufacturing space were added.

Towards the end of 1937 the largest extension, a new two-story building was completed, adding a total floor area of 40,000 sq. ft. to the existing works. The new building is modern in all respects. The large window area allows the entry of the maximum amount of light. The ground floor, is employed for finishing processes to the many moulded products manufactured in the existing works, and includes packing and dispatch departments, while on the second floor is a metal insert stores, assembly department and a works canteen capable of seating 400 people for meals.

General Extensions

Several important additions have been made in the last two years to the Switchgear Works due to the increasing demand for both large switchboards and standard industrial starters and controllers. No less than seven bays in the Main Switchgear Works have been lengthened to give more space for the assembly of switchboards of the control type, the assembly of switchboard type oil circuit breakers, and industrial type switchboards and contactor panels. A control switchboard is shown which has been completely erected in one of these bays for the Dartford Paper Mills Ltd., for whom the G.E.C. is carrying out a comprehensive paper mill electrification scheme, involving the installation of special motors and control gear, giving the widest range of paper speeds ever obtained.

A complete new story having an area of 25,000 sq. ft. has been erected over part of the existing works. This extension is actually an entirely separate shop, which is devoted to the manufacture on quantity production lines of standard starters and controllers. It is one of the largest individual shops at Witton, having a length of 460-ft. and a width of 60-ft. A general view down this important new section of the Switchgear group of works is shown.

A further interesting extension, which has been rendered necessary by the demand for industrial generators and motors, is the new coil winding and insulating shop erected as a second story over the existing winding bay in the main engineering works. This new spacious shop is 300-ft. long and 70-ft. wide and is devoted to the manufacture and insulation of coils for generators and motors ranging in capacity from 3 h.p. to 15,000 h.p. The windings for the larger machines are shaped on specially constructed wooden formers and are then insulated ready for inserting into the machines in the winding bay immediately below.

Increased manufacturing space has also been required for the production of small motor-driven appliances. During recent years the demand for these equipments has rapidly increased, and although there were already several large workshops at Witton employed in their manufacture, it was recently decided to add a complete new workshop to deal with vacuum cleaners, floor polishers, hair dryers, gramophone motors, cinematograph projectors, etc., thus enabling the other works of this section to concentrate on electric fans. The new works is entirely self-contained and possesses its own machine tool shop, winding shop, assembly bay, testing and dispatch departments.

While it is not possible to give details of all the large number of smaller extensions which have been made to Witton during the last few years, mention should be made of the new bay added to the central stores. These stores were already the largest of their kind in the country and the new bay considerably increases their capacity. Additions have also been made to the well-known Development Laboratory, and a completely new building erected next to the switchgear works for the storage of jigs. Office accommodation for the administrative staff has also been increased and the existing drawing offices extended and new drawing offices built.

Demand for Heavy Industrial Plant

The unusually wide facilities available at Witton for the manufacture of the heaviest electrical plant, combined with corresponding resources at other G.E.C. works, enable the Company to undertake the largest and most comprehensive contracts. In addition to manufacturing Everything Electrical, the G.E.C. at its Fraser & Chalmers Engineering Works, Erith, Kent, builds steam turbines, turbo-compressors, oil engines, colliery winders, coal washing plant, mining equipment, rolling mills, materials handling plant, and other classes of mechanical equipment. Thus within one manufacturing organization are made complete turbo-alternator sets, marine propulsion equipments, steam and electric winders, electrically-driven rolling mill equipments, and a vast range of electrically-driven mining and materials handling plants.

Continual attention has been given at Witton to the development of specialized types of electrical machinery and control gear capable of meeting the varying requirements of individual industries. Complete ranges of coal face mechanization plant, steelworks motors of various kinds, and motors suitable for driving textile machinery have been evolved. Traction motors and controllers have been designed in the forms most suitable respectively for railway, tramway and trolley buses. Motors possessing the essential characteristics for machine tool drive have been introduced, and a marine type motor for driving auxiliaries has proved fully able to withstand the conditions of service on board ship. Control schemes have been devised for paper-making machinery, pumping equipments, swing bridges, and for fulfilling numerous other functions.

Uses and Sources of Tungsten

WOLFRAM, which is attracting attention because of its recent rise in price, is one of the tungsten-bearing materials. Tungsten occurs in nature as tungstates of iron (ferberite), of manganese (huebnerite) and of calcium (named scheelite after the eighteenth century Swedish chemist who discovered its composition). Wolfram, a mixture of ferberite and huebnerite, is the world's principal commercial source of tungsten.

The uses of tungsten are limited but important. It is employed to make filaments for electric lamps, wireless valves and contact points in electrical apparatus. Its compounds are important in the chemical field, particularly in the production of certain types of dyes (lakes) and mordants. In general, the chemical outlets for tungsten materials are growing. But these applications account for only minor amounts of the metal. Its major quantitive use is in metallurgy.

Speed, the perennial demand of modern industry, presents especially difficult problems to mechanical engineering.

Tungsten, whether as a steel alloy or alloyed with certain non-ferrous metals, enables these problems to be solved. Thus, a steel containing 14 to 18 per cent tungsten, together with carbon, chromium and vanadium in certain proportions, possesses the property known as " red hardness." This means that, for example, a lathe tool made from such steel will keep its cutting edge when the tool itself is red-hot from friction.

Certain non-ferrous alloys possess these qualities to an even higher degree and tungsten is an essential ingredient in their composition. It is used not in its metallic form but compounded with carbon as a carbide. Many carbides are, of course, noted for their hardness and resistance to high temperature. Carborundum is an example with which most people are familiar. These properties appear particularly in tungsten carbide. In this form tungsten cemented with cobalt can be used alone for tool making or it can be used in combination with other unusual metal carbides similarly cemented.

Cemented carbides, besides their uses as cutting tools, are also employed to make the wearing surfaces of machines and dies for wire-drawing, their life in such uses being in some cases a hundred times that of steel. Tungsten steel alloys are also applied for the same purpose.

Modern high-speed steels and cemented carbides have revolutionized machine shop practice. The use of cemented carbides is a particularly recent development, because machine tools with sufficient rigidity and power to utilize their inherent qualities had not previously been developed. Equipment of this type was in heavy demand even in 1935. The increase last year and this in armament production has given an additional stimulus to just those branches of heavy engineering where tungsten alloys are most needed and used. While armament production continues throughout the world at its present level the demand for tungsten alloys may further expand.

Information about the world production of tungsten concentrates is rather scanty. The principal supplying continent is Asia, which accounted in 1934—the last year for which reasonably full statistics are available—for over two-thirds of the world's supplies. North America was the next largest continental producer, followed by Europe and South America.

Railway Transport in the Far East

By BRIAN REED

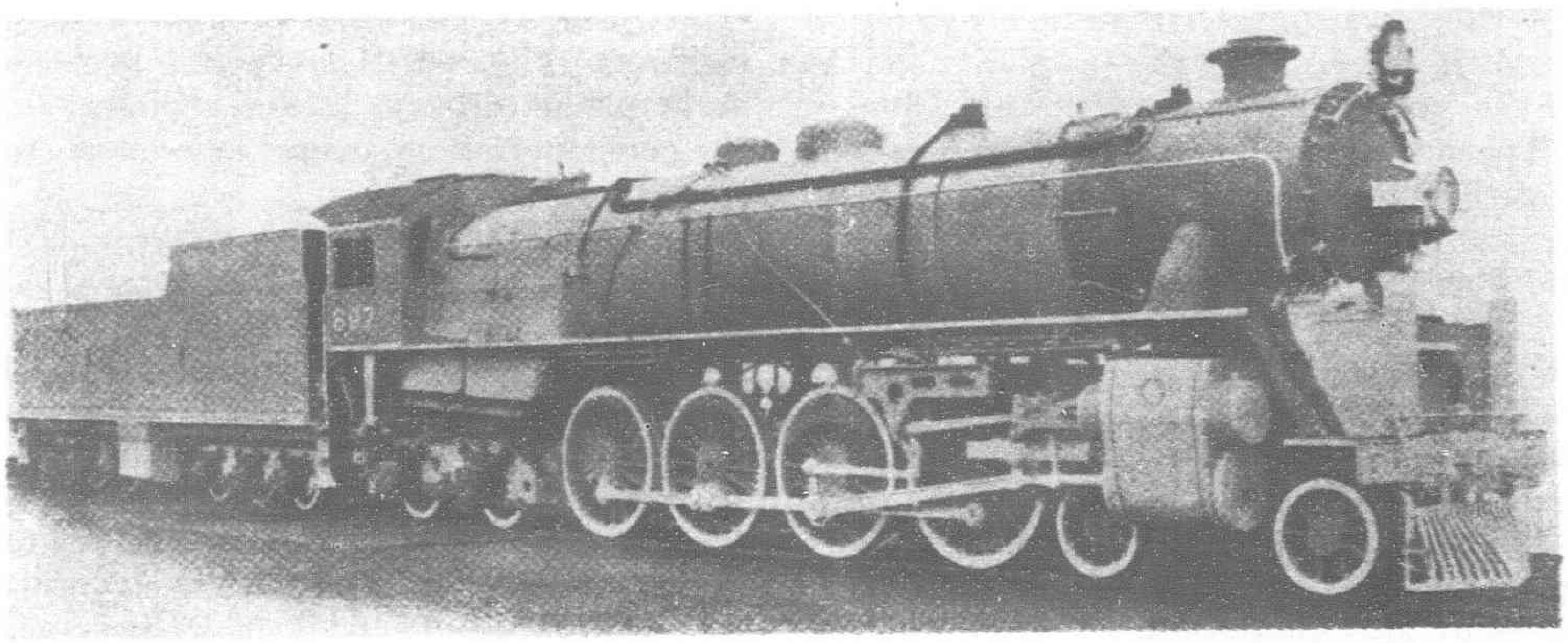
The following brief survey of railways in the Far East, written before the outbreak of Sino-Japanese warfare in China, was published in Eastern Engineering and Commerce, and has points of special interest at this time.

* * *

RAILWAY activity has been most intense during 1936 in the Orient. The rapid commercial development of China is leading to the projection and construction of numerous railways by the Ministry of Communications in Nanking; further north, the consolidation of Manchoukuo has brought forth a whole crop of new lines, and even in Japan about 300 miles of new line were opened.

China

The principal event of the year 1936 was the completion of the great Canton-Hankow Railway, and the inauguration of a service with through connections between Peiping and Canton. At the moment, the train ferry over the Yangtze is not in operation, and separate trains are run from Canton to Wuchang, on the south bank, and from Hankow, on the north bank, onwards to Peiping. The time for the 700-mile journey from Canton to Wuchang is 44 hours. Passengers from London to Canton already have been booked for the all-railway route via Siberia, Mukden, and Peiping.



One of the twenty-four giant British-built locomotives for the Chinese railways

The Peiping-Hankow division has been in operation for years, and in 1933 the construction of the 252-mile gap between Shinchow and Chuchow was begun; it is this section which was completed in 1936. It has a ruling grade of 1 in 100 uncompensated, there are 14 tunnels and three major bridges. The rails are in 40-ft. lengths, weighing 85-lb. per yard; generally the track is single and the trains are worked by the big 4—8—4 engines built by the Vulcan Foundry in 1935. Also connected with the operation of this line is the enlargement and development of Whampoa harbor on the Canton river, which is to be joined to the trunk line by a branch 13 miles long.

Other new lines completed were a western extension of the Lunghai railway from Sianfu to Mechsien; the Yushan-Nanchang section of the Chekiang-Kiangsi railway, which included the great bridge over the Fu river; the Hangchow-Shaohsing prolongation of the Shanghai-Hangchow-Ningpo Railway; and the Hwainan mineral railway, which brings 2,000 tons of coal a day down to the Yangtze opposite Wuhu. An important extension of the Chekiang-Kiangsi line is under way, and also a new line from Chengtu to Chienkiang; the latter is being financed by French capital. Further, a 110-mile westward extension of the Peiping-Suiyuan Railway has been sanctioned by the Nanking Ministry.

During the year was floated the 25th Railway Construction Loan, to the amount of $120,000,000, bearing interest at five per cent. This money is to be devoted to lines in Hunan, Kwangsi, Kweichow, and Szechuen, which are urgently needed from economic, political, and military points of view. Surveys have been made for many lines, of which the two most important are (*a*) a line running west from the Canton-Hankow Railway at Chuchow to Hsianghsiang, and intended to form the first link of a new east to west route through the province of Hunan into Kweichow, and, eventually, part of a great trunk line from Shanghai through Hangchow, Yushan, Hunan, Kweichow, to the farthest reaches of the Yangtze; and (*b*) a long southwestern offshoot of the Lunghai Railway from Paochi to Chengtu, the capital of Szechuen province, a distance of about 400 miles. Chengtu itself is at present being linked with Chienkiang, on the upper half of the Yangtze, by an isolated line 180 miles long. At long last it was decided in 1936 to build a 300-mile line joining Canton and Swatow, and the estimates show a construction time of five to six years, and a cost of $300,000,000, the first part of which is to be financed out of the 25th Railway Construction Loan.

The Taokow-Chinghua railway, built 33 years ago, has been amalgamated with the Peiping-Hankow Railway, and the administration concentrated at the offices of the latter. The Lunghai line is to be provided with new locomotive, carriage and wagon repair shops near Sian, and the construction of these is being financed by Belgians. Another big work to be undertaken by the Lunghai is a junction with the Tatung-Puchow line by means of a $3,000,000 bridge over the Yellow river at Tungkwan. During 1936, over 20 locomotives, 50 carriages, and 100 wagons were delivered to the Lunghai line by British and Belgian manufacturers, and British, Polish, and Czechoslovakian engines were shipped for other railways.

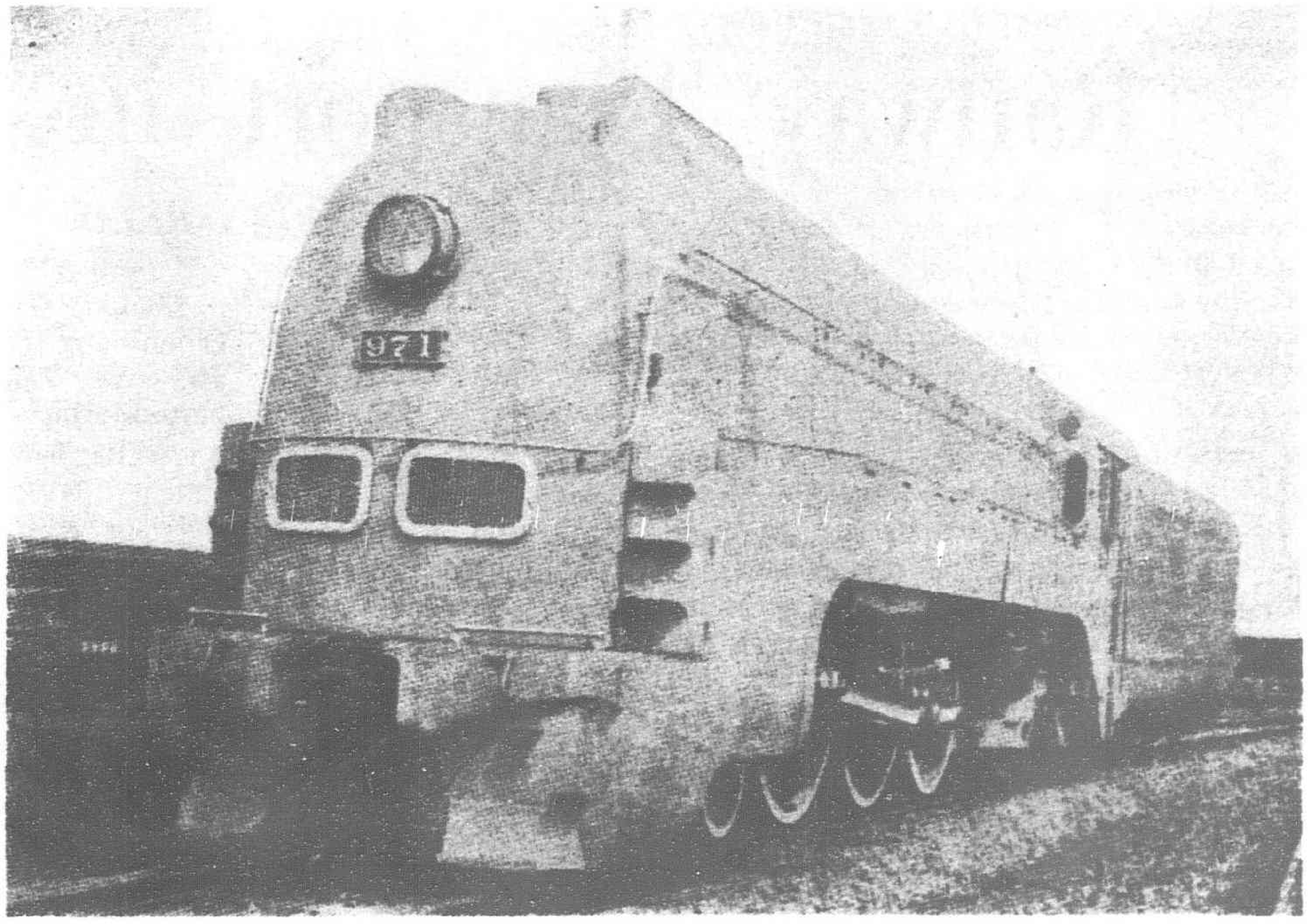
Six railcars have been ordered by the Peiping-Liaoning Railway in order to give more frequent and accelerated services on branch lines. Railcar trains were tried on the Woosung branch out of Shanghai and on the Kowloon-Canton Railway. The last-named line has also converted one of its carriages into a buffet car, which normally runs between Kowloon and Canton, but which is slipped three times a week at Fan-ling station.

Considerable acceleration has taken place in the journey between Nanking and Shanghai, and at the end of 1936 the schedule of the main expresses was reduced from six hours to four hours 50 minutes. Some of the westbound expresses are to connect with a new fast boat service up the river from Nanking to Hankow, and two 3,000-ton boats are being built to make this connection. The new station and administration buildings of the Chinese National Railways at Shanghai were opened in July, and replace those bombed by the Japanese in 1932. Accelerations were made also in the through service from Peiping to Shanghai, via the Nanking train ferry, the schedule being cut from 38 hours to 35½ hours, and through services from China to Manchoukuo, via Shanhaikwan, were resumed.

Indo-China

By far the greatest railway event in Indo-China during 1936 was the completion of the important north to south trunk route down the coast, linking the capital, Hanoi, with the big town of Saigon, in the far south. From beginning to end this line has taken 34 years to build, but it was undertaken in stages, the work on the last section of 470 miles, from Tourane to Nhatrang, beginning in 1932 and finishing in October, 1936. Through trains now run right through from Hanoi to Saigon.

Intense road competition between Hanoi and Haiphong caused the Yunnan Railway to put into service six French-built Diesel railcars. These vehicles have been most successful, and have recaptured much of the inter-urban traffic; they have been introduced, too, on the main line into the Chinese province of Yunnan, and they have reduced the time for the 530 miles from Hanoi to Yunnan city from about 35 hours to 17 hours. During the year the contract of the Yunnan Railway with the French colonial authorities was revised, and the exemption from taxation and customs duties of the employees was severely limited. The railway will also now share the cost of policing the district, and a Chinese liaison officer is to be appointed. There has also been a great deal of co-operation between the Yunnan and State lines in an endeavor to check the competition of road interests and river services. Early in the year the private Pnom-Penh-Mongkolborey Railway, 200 miles long, was taken over by the Indo-Chinese State Railways. It lies in the province of Cambodge, and is connected with the State lines at Mytho only by a boat service down the River Mekong.



Streamlined "Pacific" locomotive used for hauling the "Asia Express" on the South Manchuria Railway in Manchoukuo

Manchoukuo

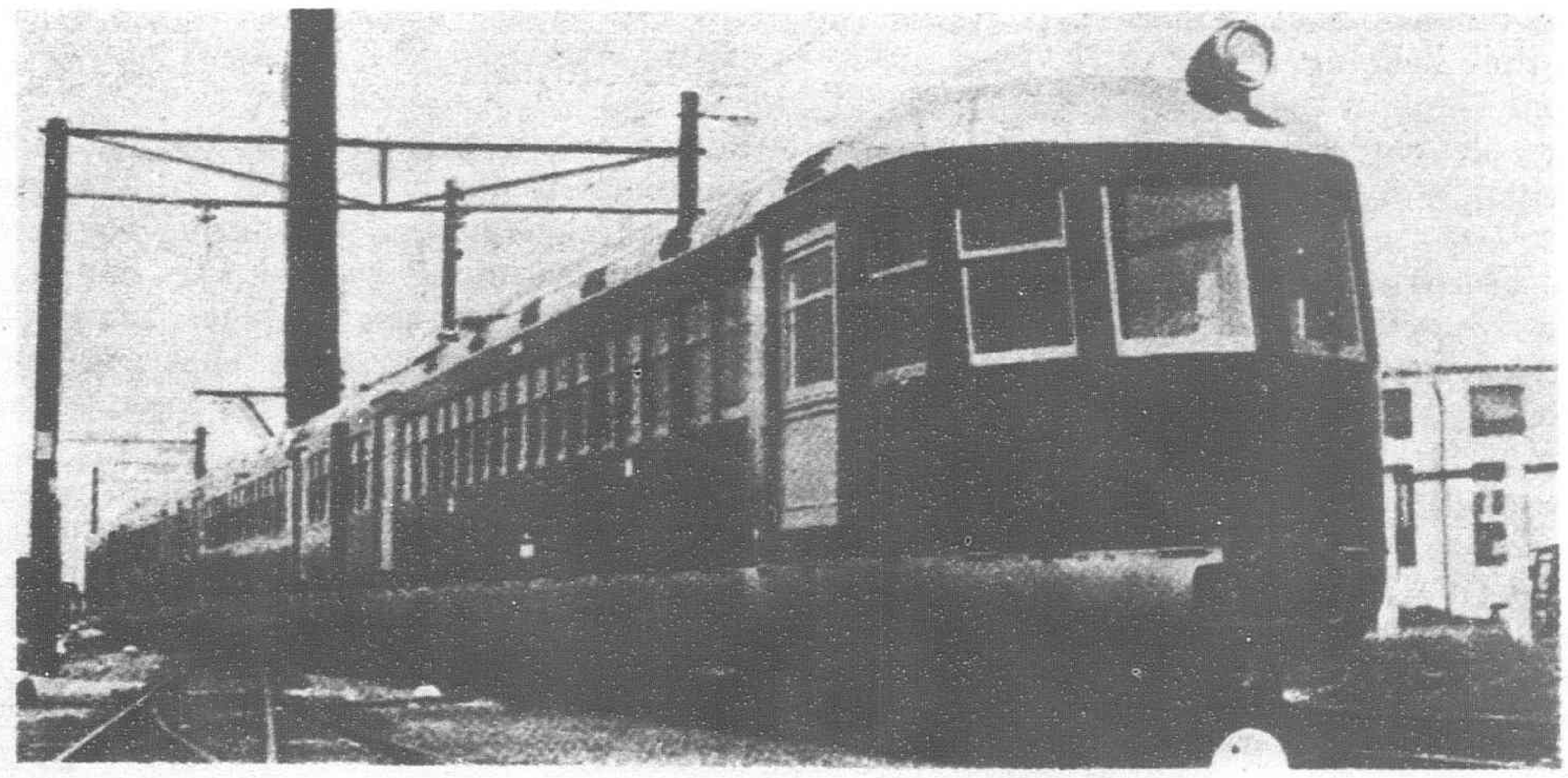
The first great program of new construction drawn up for what is now the Manchoukuo State Railways was virtually completed in 1936. Projected shortly after the Manchurian incident of 1931, it embraced more than 2,000 route miles of line, principally north of Hsinking, and the first two lines of major importance built under it were the Tumen and Lafa-Harbin sections. Most important among the last divisions opened in 1936 were the Jehol, Solon-Hulan Arshan, Noho-Mergen, and Linkow-Mishan routes.

A new program of almost the same mileage has been drawn up, and no bones have been made about announcing the real purpose of these new projects. The plans have been worked out by the staff of the Kwantung Army, in conjunction with the Imperial Army staff in Tokyo, and the proposals consist almost entirely of lines to the north and west of the old Chinese Eastern Railway, which will permit of rapid concentration of troops on inside lines at any part of the Siberian and Mongolian frontiers, and designed to take advantage not only of Dairen, but also of the new port of Rashin and the old neighboring ports of Seishin and Yuki. Already the construction of 440 miles of line has begun, and the estimated cost of the whole program is a minimum of Y.400,000,000.

As from October 1936 the unification of the State Railways and the South Manchuria Railway advanced a big step, and the reformed Manchoukuoan Ministry dealing with transport is to include also a department of industry. A portion of the Chosen State Railways was also brought into the net, for the higher Japanese policy regards as essential an integral railway system on the mainland. Despite these unifications as to management, the South Manchuria Railway is to remain financially independent. In accordance with the apparent general desires of Japanese financial circles, a number of the widespread ancillary undertakings of the S.M.R. are to be sold. The revenue of the S.M.R. for the year ending March 30, 1937, is estimated at Y.300,000,000, and the gross expenditure, including interest charges, at Y.250,000,000.

In many quarters the sale of the ancillary works and the retrenchments in recent budget figures are believed to be harbingers of a policy of S.M.R. domination in northern China, on the lines followed for 30 years in Manchuria. Already the S.M.R. is reported to have opened offices in Chahar, Suiyuan, and Tientsin, and a China Bureau has been created as a separate department of the railway. The S.M.R. even has proposed that it should take over and run the railways in north China, and in return it would finance the construction of several new lines—rather a double-edged sword, this.

The streamlined Asia Express of the S.M.R. now runs right through from Dairen to Harbin, but a lighter engine is put on at Hsinking and the speed reduced for the continuation to Harbin, for this stretch still has much of the old Chinese Eastern Railway permanent way, although it has been converted from 5-ft. to 4-ft. 8½-in. gauge. Further streamlined 4—6—2 engines have been placed in service on the southern part of the main line, and some huge 4—6—6 tank locomotives are being used for medium-distance trains on the Dairen-Mukden-Hsinking line. They were built in Japan and weigh 102 tons; their normal trains consist of three special coaches which are worked to fast timings. Oil-engined railcars and set trains were set to work on branch lines of the State Railways during 1936, and unification on a sliding scale of the goods and passenger fares all over the State and S.M.R. lines was carried out. Special low rates were sanctioned for the carriage of agricultural products from the north part of the country.



One of Japan's electric trains

Japan

As is usual in a fully-developed country, railway progress from year to year is to be judged not so much by new lines opened as by the improvement in details of operation and equipment, greater traffics, and accelerated travel. Nevertheless the new lines opened in 1936 amount to about 300 miles, and bring the total for the State-owned network up to almost 11,000 miles. Something like 500 miles of new line have been sanctioned recently, principally in the Hokkaido and Honshu islands, but construction is to be spread over several years.

On the Tokkaido main line, improvements have been made by admitting third-class passengers to all trains, and in certain instances by dispensing with first-class accommodation, even on the long-distance trains. Stream-lined steam and electric locomotives made their appearance on the Tokkaido route, and the present schedules from Tokyo to Kobe and Osaka are very fast considering the distance and the narrow gauge; maximum speeds in excess of 58-60 m.p.h. are not uncommon. Of

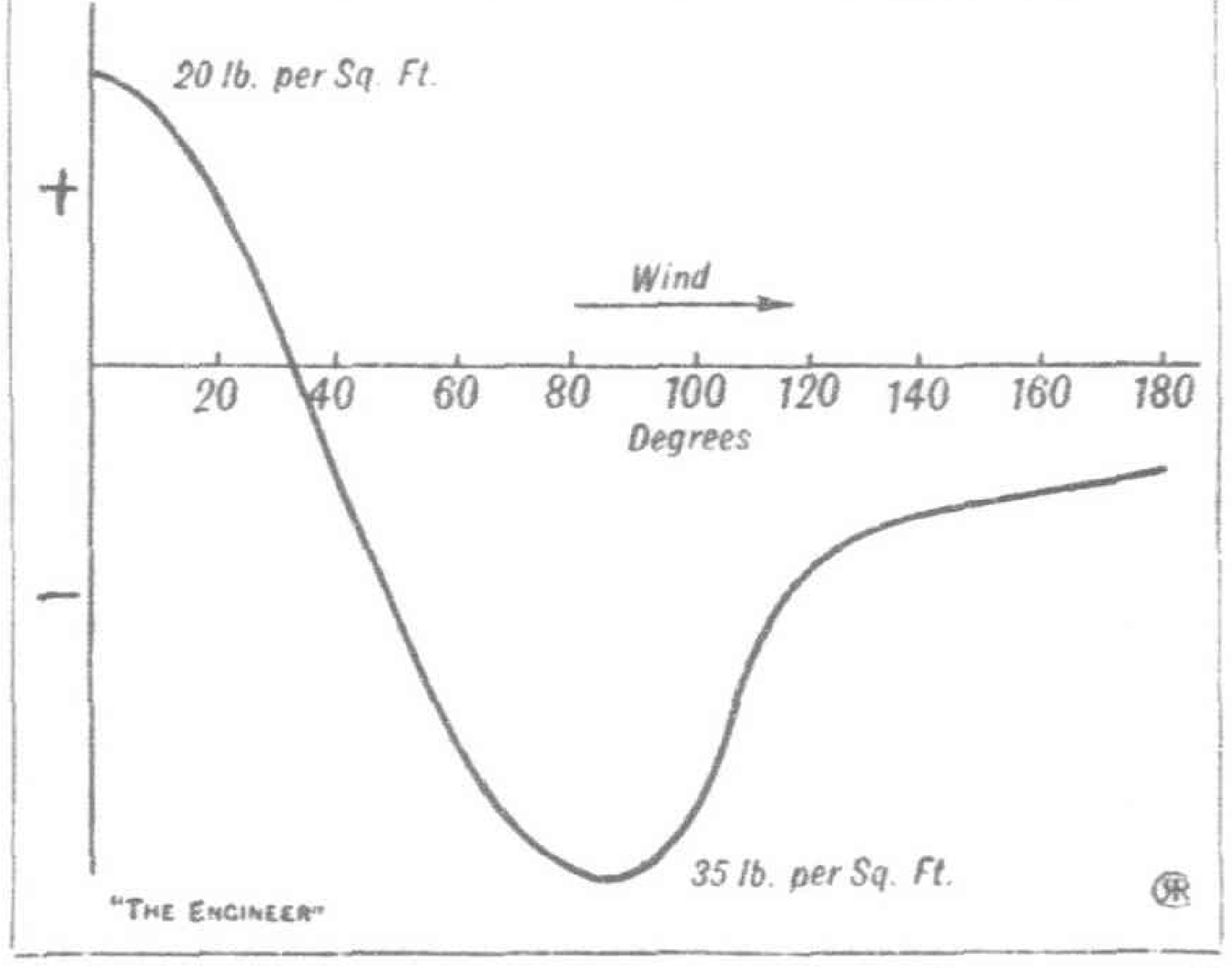
(Continued on page 29)

The Action of Typhoons on Structures

(By a Correspondent in The Engineer)

Many places on the South China coast, including the port of Hongkong, have frequently suffered from the effects of winds of very high velocity. Wind velocities, approaching those of tropical storms, are unknown in Europe. Professor J. Ackeret, of Switzerland (Professor E.T.H. Institute of Aerodynamics), writes: " It is found that in our countries even in a severe gale the velocity scarcely exceeds 90 kiloms (56 miles) per hour." It will, therefore, be realized that a wind velocity of 164 m.p.h., which was recently recorded in Hongkong, produced terrifying effects upon residents and carried death and devastation in its path along the coast. There have been several occasions when velocities exceeding 130 m.p.h. have been recorded in Hongkong. In August, 1931, a gust or squall velocity of 136 m.p.h. was recorded from E.N.E., when the typhoon was within 50 miles S.W. of Hongkong.

These terrific gales present problems of great scientific interest, the solution of which are of importance to engineers. Our knowledge of the laws of Nature increases each year, chiefly as the result of experiments. Many previously unknown factors are thus revealed. For example, it will probably surprise readers of this journal to read that Professor Ackeret has recorded that during certain researches on a vertical cylinder (a model gasholder) in a wind tunnel, he found that the suction effect of a high wind on the leeward side of the cylinder, near to the roof, was actually 1.7 times in magnitude that of the pressure effect on the windward side of the cylinder.



Wind pressure on a gasholder

The Hongkong Typhoon

The typhoon which struck the British Far Eastern Colony in the early hours of Thursday, September 2, 1937, was the fiercest within living memory. It is impossible to obtain reliable figures, concerning the total number of deaths caused by this terrible wind, but estimates have reached 10,000. Nearly 1,200 Chinese junks and sampans in the waters of the Colony were wrecked, and also large numbers in Chinese waters. In Hongkong harbor twenty-seven ships, many of them large ocean-going steamers, broke loose from their moorings and were piled up on the beaches or in shallow water. These vessels included the Italian *Conte Verdi* (18,765 tons), the Japanese *Asama Maru* (17,000 tons), the British B.I. *Talamba* (8,000 tons). The fact that these large ships had left the wharves and found anchorages in sheltered positions within the harbor some eight hours before the typhoon struck the Colony, and were fully prepared with steam up to ride the storm, gives some idea of their helpless state in the presence of this terrible freak of Nature.

The neighboring Portuguese Colony of Macao, 40 miles distant, was also a victim of this typhoon.

A startling phenomenon of the typhoon was a great tidal wave which swept along Tolo Habor (in British waters), and rushed across the land, wiping out houses, and carrying junks and sampans hundreds of yards inland. This great towering wall of water is said by survivors to have been at least 30-ft. high. It rampaged over the Taipo sea wall, inundated villages and rice paddy fields, and only ended its mad career when it reached the foot hills.

Typhoon Warnings

Authentic records of typhoons in Hongkong were begun in 1884. Since that date the Royal Observatory in the Colony has made efforts to issue warnings of the approach of these dreaded storms. Usually the first signal goes up at least twelve hours before the typhoon arrives. There are, of course, many more signals before the final warning. The latter is the noise of three bombs which announce that " The typhoon is here."

The paths selected by these storms are most erratic. They form in the vicinity of the Philippine Islands, and the majority miss Hongkong. Some travel as far north as Japan before they break up on reaching land. In the early days of the Colony's observatory, the only information available was provided by cables from Manila, where there is an excellent meteorological station, and local observations. In recent years, however, there has been organized wireless communication between the Hongkong Observatory, other land stations, and ships at sea. This system has caused immensely improved weather forecasts in Hongkong.

During the fifty-four years, between 1884 and 1937, seventy-four typhoons have struck Hongkong. In September, 1906, a typhoon arrived without any warning being issued by the Observatory. Local residents had noticed that the natural shelters for junks and sampans were filling up with these vessels for several hours before the typhoon arrived, although the weather seemed bright and sunny, but Europeans relied on the Observatory and underestimated the precautions of the Chinese. Incidentally it is worth recording that the writer has often noticed typhoon shelters filling up with Chinese craft several hours before the first warning of unusual atmospheric conditions has been issued by the local Observatory. There is some weather sense, either instinctive or traditional, possessed by Chinese mariners that is unknown to Europeans.

The Speed of Typhoons

In the Pacific a typhoon as a whole starts slowly at a speed of about 8 m.p.h., usually in a N.W. direction, in latitude 10 deg. N., but when it reaches Hongkong (latitude 22 deg. N.) it is usually moving at about 15 m.p.h. The recent typhoon, however, was moving at the very remarkable speed of about 35 m.p.h. W.N.W., when it reached the harbor of Hongkong. As it approached, the wind velocity recorded in the Observatory rapidly increased. Unfortunately, at 130 m.p.h. the instruments there broke down, but a local engineer has stated that his wind velocity instrument recorded a maximum of 164 m.p.h. On other occasions local Observatory instruments have been unable to register velocities exceeding 140 m.p.h. when they occurred, but it is doubtful if 164 m.p.h. has been exceeded in the China Seas.

As a typhoon reaches Hongkong, the wind is usually in a direction about N.E., following the cyclonic whirl; when there are no typhoons, this is the direction of the prevailing winter gales, so that structures in the Colony, where possible, should be protected from the N.E. When the typhoon center, which is small in area and is comparatively calm, has passed the Colony, the wind direction of the cyclonic whirl is reversed, and is usually about S.W., until the typhoon as a whole is clear of the locality.

The Failure of a Gasholder

About three years ago (May 14, 1934), there was a terrible calamity in Hongkong, owing to the failure of a large gasholder. Subsequent investigations revealed some very interesting facts, which have never been recorded in this journal, but which are of the utmost importance, not only to gas engineers, but to all structural engineers, especially those working in the tropics. The failure of the gasholder was due to a steel plate or plates, forming a portion of the envelope, breaking down and permitting about 350,000 cubic feet of gas to escape. This large volume of gas became ignited, and produced a great flame which was carried by the wind through houses about 100-ft. distant, and the fire caused forty-two deaths.

There can be no doubt that the fundamental cause of the failure of the plate was the unexpected suction effect on the leeward side of the holder, produced by the high-velocity N.E. gales prevalent during the winter, and which are particularly fierce when typhoons strike the Colony.

The plates that failed were on the S.W. area of the holder, i.e., on the leeward side of the N.E. winds. They were on the top lift, near the roof of the holder. The N.E. side of the holder was not protected, but, indeed, was particularly exposed by a road behind it, running in a direction N.E. to S.W. Thus there were no buildings to shelter and break the force of the N.E. wind coming off the sea, although buildings, etc., protected other parts of the holder. The holder was situated not far from the harbor and was on reclaimed land. A smaller holder, adjacent but well protected by buildings, etc., had been in use for more than forty years.

During the inquest on a victim of this tragedy an expert witness advanced the theory mentioned above, viz., that the N.E. gales had produced a very great suction effect on the leeward side of the holder. He said that the unfortunate position of the holder and the fact that engineers had up to that date not taken into consideration the suction effect produced by high winds, made it reasonable to suppose that the real cause of the failure could not have been foreseen until subsequent investigations revealed it.

It is well known that the suction effect of the air on the upper surface of an aeroplane wing has a much greater effect in lifting the machine than the pressure on the underside of the wing. This suction effect must be very great at 450 m.p.h. Recent researches on the sails of a vessel at sea have given results which surprise yachtsmen, for they show that " the suck " on the leeward side of a sail does more to drive the vessel along than the pressure on the windward side.

Professor Ackeret's Experiments

For some years previous to this calamity in Hongkong gas engineers had been concerned about the strength of gasholders. The plates forming the envelope of the holder in Hongkong were originally one-tenth of an inch thick. On the N.E. side of the holder there was very little corrosion, but many of the plates on the S.W. top area had been patched externally during previous years. They were considerably reduced in thickness at the date of the calamity but, the plates on the N.E. top area had suffered very little corrosion. Measurements showed that in some places on the S.W. top area of the lift, the plates were only one-fortieth of an inch thick at the time of the failures. That fact, of course, was not revealed during the frequent inspections of the external portion of the holder.

The plates were stayed against wind pressure, but were free to move outward if there was a partial vacuum on the leeward side. In a typhoon or in a gale a feature of the wind is the variation in velocity of the squalls. This must have varied both the pressure on the windward side and the vacuum on the leeward side. The plates on the windward side did not move, but on the leeward side they continually bulged in and out.

Thus it will be seen that the plates on the leeward side were in a constant state of movement during typhoons or gales, because the squalls produced a rapid fall and frequent variation of atmospheric pressure on the leeward side of the holder. The plates on the windward side were not in motion, because they were pressed against the stays all the time of the gale.

In October, 1934, a few months after the Hongkong failure, there was published by the Escher Wyss Engineering Works, Ltd., a bulletin containing the remarkable results of wind pressure experiments on a model gasholder. These experiments were made by Professor J. Ackeret. They must have been planned before the Hongkong tragedy (May, 1934), which is evidence that Mr. F. Escher, the director of the City Gasworks, Zurich, was anxious to have definite data on the subject to guide the designers of a 3.5 million cubic feet holder, which had been ordered for Zurich.

The highest air velocity used in the experiments was a 112 m.p.h. An under-pressure or negative loading of 35 lb. per square foot was recorded with a gale velocity of 130-ft. per second (say, 88 m.p.h.), whereas the positive pressure on the windward side was only 20 lb. per square foot. " Under-pressure exists over the whole of the leeward side of the reservoir " is a statement of the utmost importance, but, of course, it is greater in magnitude as velocities increase. The diagram shows the variation from + to — pressures on one-half the circumference of the holder. The readings on the two halves of the circumference were uniform. The readings were taken at the top of the vertical cylinder near the roof of the model holder.

The importance of these results can be summed up in the statement made by Professor Ackeret: " In the old methods of calculating absolutely no consideration was given to the effect of under-pressure at these dangerous positions." It is certain that the negative pressures must be much greater with a wind velocity of 164 m.p.h. than at lower speeds.

There is one conculsion reached by Professor Ackeret which the writer believes explains the cause of the Manchester gasholder failure in 1927. He writes: " The roof of the reservoir, principally towards the front edge, is likewise subjected to very severe under-pressures." Mr. Stanford, who conducted the Government inquiry concerning that failure, in his official report found that the plating on the roof of the holder was weakened by corrosion and collapsed. It seems certain that it was the constant under-pressure—varying in intensity with each squall—that made the roof vibrate, stressed the plates continuously during a gale, accelerated corrosion, and finally caused the plates to fail.

The holder in Hongkong had been in use for only twenty-six years, whereas the economical life of a holder is, in practice, reckoned to be about forty years. The " panting action " caused by the negative pressures on the leeward side of the holder were, it seems certain, responsible for (*a*) the excessive corrosion of the plates on that side (the corrosion was mainly produced by constant vibration and " panting " during many typhoons and gales in previous years), and (*b*) the final negative pressures on the day of calamity.

It cannot be doubted that Professor Ackeret's results are of the utmost importance, not only to gas engineers, but to structural engineers, working in regions where there are winds of high velocity.

The Effect of Squalls and Rain

Scientific observers in the Far East are of the opinion that typhoons are more or less destructive, depending on the different frequencies of the fierce wind squalls.

During a typhoon in Shanghai in August, 1921, it was possible to register by means of a very sensitive Richard statoscope a general mean of nine squalls per minute. As many as 230 squalls were registered in 24 min., and also in the same typhoon a minimum number of 175 squalls in 24 min. These squalls are separated by comparatively calm intervals, which, of course, increases the impact effect of the squalls.

A German engineer of the Telefunkem Company, in 1925, had to erect two 70 m. high wireless masts in the Pratas Shoal (China Sea). He consulted the Shanghai Observatory officials, who mentioned the four-to-eight seconds periods of the squalls. The engineer based his design on the statement. All of the steel guys of the masts were divided into portions, so as to avoid a natural period of oscillation in the region of four to eight seconds. The masts have remained intact, although every year from one to three typhoons strike that desolate coral reef wireless station, erected for the Chinese Maritime Customs Service and recently taken over by the Japanese.

Another phenomenon of great importance to the stability of structures in typhoon gales is the angle of the impact of the wind. Numerous reports from ships' masters and observers ashore confirm the belief that at least in the first moment of the squall the wind blows almost horizontally. Just near the ground there may be a friction effect, reducing the horizontal component, but it seems certain that at 30-ft. or 60-ft. above the ground the impact during the first few seconds is practically horizontal.

It is essential to mention the rain which invariably accompanies these squalls. Dry air weighs 0.0013 grammes per cubic centimeter, but water weighs one gramme per cubic centimeter. The International Tables show that with a wind velocity of 150-ft. per second (112½ m.p.h.), the dry air pressure on a structure is 26.75 lb. per square foot. But if during a few seconds some of the fierce typhoon squalls are practically wholly rain, this gives a reasonable physical explanation of the extraordinary effects reported from typhoon-stricken areas. Steamer funnels have been blown away like straw. In 1936 a typhoon in Hongkong lifted the roof from a house, carried it with terrific force against a strong electric power transmission pylon, which was crumpled up by the impact. Nearly every house in any exposed position in Hongkong had portions of the roof carried away in the 1936 and 1937 typhoons.

In the recent typhoon a big riveted steel tank, empty at the time and weighing 14½ tons, was lifted bodily from a hill and deposited some distance away. It obviously did not slide down the hill because none of the trees on the hillside, thickly spaced, showed signs of damage by it, although, of course, in places they were uprooted by the gale. There can be no doubt that the tank was carried some distance in a horizontal direction.

In 1894 a typhoon in Indo-China lifted up two big spans of an iron bridge, " weighing several ten of tons each," and deposited one upstream and the other downstream.

The United States Weather Bureau (1931) reports a case in a tornado in the Southern States when one car, weighing 64 tons, of a railway tram, with 117 passengers, was lifted from the rails and carried through the air to be laid in a ditch 80-ft. away.

There are enormous increases and decreases of the atmospheric pressure over the ground or the sea surfaces during typhoons. Does this produce a tidal wave ? It does produce great variation in loadings and unloadings on a roof, and this suction effect helps to explain why it is that often roofs are removed many hundred yards, whilst walls are left standing. But it is a common experience that windows and doors on the leeward side of a building collapse outwards and not inwards. This must be due to the suction effect of high-velocity winds, which is obviously much greater than the pressure effect.

It seems probable that if a typhoon wind strikes the side of a ship there is also a great vacuum or under-pressure on the leeward side. Both forces must tend to drive a drifting ship on to the lee shore.

Let us consider the effect of rain. If we assume a wind speed of 200-ft. per second (say, just under 140 m.p.h.) and pure rain water projected horizontally against one square foot of vertical surface, the pressure produced would be more than 1½ tons per square foot. With dry air the value would be about 65 lb. per square foot—a very great difference.

Even if these " rain squalls " contain only 50 per cent of pure water, there is a large difference between the pressure values to be encountered during these " thick rain squalls," and the 56 lb. per square foot recommended by the Board of Trade rule as the maximum to be expected, as quoted in Dr. Stanton's paper (" Proceedings," Institution of Civil Engineers, Vol. 219, page 125). In the case of a ship battered at sea by a typhoon, the condition of thick sea or rain replacing dry air accounts for the extraordinary twisting and shearing damage reported by ships' masters. This terrific influence of water in stressing structures must have been taken into account when designing lighthouses along the China coast, or the experience of the freakish effects resulting from typhoon made designers use a very high factor of safety.

The cause of the failure of the Hongkong gasholder has been mentioned because it was the manager of the Copenhagen gasworks, J. O. V. Irminger, who first published experiments giving results in an article on " Wind Pressure on Buildings and Other Structures." Dr. Stanton, in a classical paper (Institution of Civil Engineers, Vol. 171), showed that with a wind of 20 m.p.h. the resultant negative pressure on the leeward surface of a roof at 36 deg. was — 0.82 lb. per square foot. Many wind tunnel experiments have been made in connection with aeronautical research since that date. Has the effect of heavy rain during squalls been considered ?

These facts concerning very high velocity gales are of great practical importance. Our knowledge concerning the laws of Nature increases each year, but many natural phenomena are still only partially explained. Small wonder that primitive man, in tropical regions, felt helpless in the face of the anger of his gods ! The engineer has reduced some of the ancient terrors. The modern methods of obtaining data concerning the approach of typhoons, and the signals sent out by observatory officials, have immensely increased the safety of ships at sea and of people on land. In the old days it was the sudden arrival of a typhoon that made it so dangerous.

In Hongkong two large areas of the harbor water have been enclosed by sea walls, thus providing typhoon shelters for small craft—junks, sampans, launches, and yachts. There are also a number of natural typhoon shelters in narrow bays and inlets which become crowded with craft when a typhoon is expected. A ship at sea can usually navigate away from the path of a typhoon.

It is, however, obvious that our knowledge of the action of high-velocity winds and rain storms is by no means complete. There is an attractive field for research work on that subject.

HEAVY STOCKS OF RAYON

The Japanese Ministry of Commerce and Industry, concerned at the glut of rayon in the market, is considering the advisability of enforcing a system of compulsory mixing of silk and cotton with rayon (states Reuter's *Weekly Trade Review*), and has also resolved to induce rayon producers to scrap their old machines, meanwhile allowing them to curtail production radically. It is not yet known whether the Ministry will introduce regulations similar to those for the compulsory mixing of staple fibre in woollen goods, but it evidently desires to avoid any legislative step, and hopes to induce producers to conduct such control voluntarily. The Ministry is anxious to adjust the paradox of production curtailment on the one hand and plant expansion on the other. Its intention is to induce producers to scrap old and superannuated plants rather than suspend extension schemes already in hand. It believes that such an arrangement will conduce to higher efficiency and lower costs of production.

According to investigations by the Ministry, the stock at Japanese warehouses alone is about forty million pounds. If the stock held by Japanese mills and shops is taken into account, it is obvious that the total quantity will be enormous. Last summer the stock was less than ten million pounds. While it is true that this heavy increase has been caused partly by poor sales both at home and abroad, it is also undeniable that the control of production has not been progressing properly, and so the Ministry has decided to induce the Producers' Association to rationalize its control. According to the plan drafted by the Commerce Department, the new average rate of curtailment will be 59 per cent, against the existing rate of a little over 40 per cent. This will be the second highest rate of curtailment enforced in Japanese key industries, the highest being that for the cement industry, viz., 62 per cent. The actual rate of curtailment under the plan is 55 per cent at large mills and 53.125 per cent at small mills. If, however, the restriction of newly-installed spinnerets is taken into consideration, the average rate will be about 59 per cent.

Railway Transport in the Far East

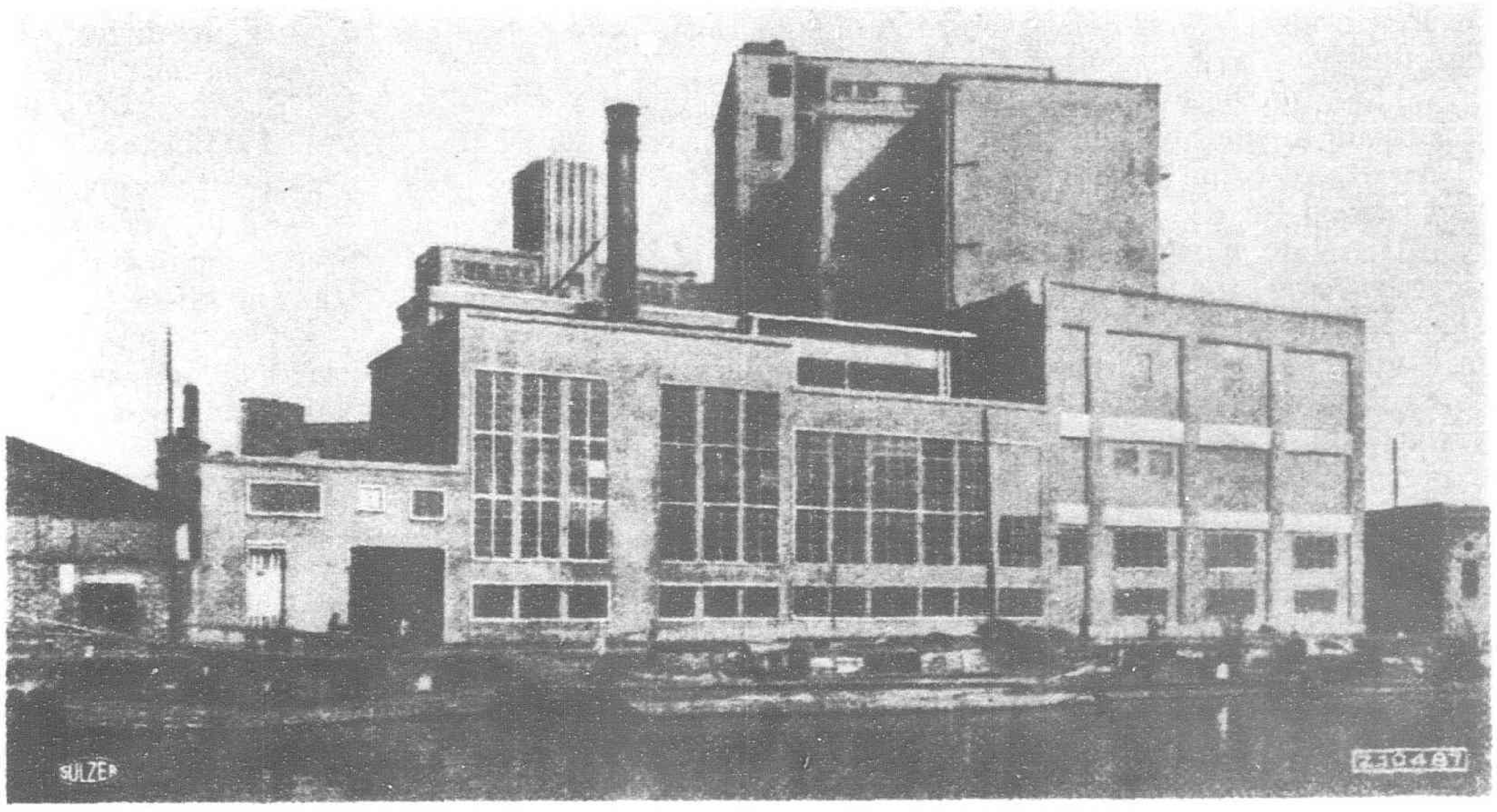
(Continued from page 26)

course, some of the improved timings in recent years are due to the easier alternative loop through the Tanna tunnel, opened in 1934. A prolongation of the far end of the Tokkaido route is now under way with the construction of Kwammon Straits tunnel, connecting Shimonoseki and Moji.

Streamlined four-car electric trains for fast inter-urban services between Tokyo and Yokohama and from Kobe to Osaka were introduced. They are of all-steel welded construction with pneumatically-operated doors. A 480 b.h.p. streamlined Diesel train of three cars was built in 1936 for experimental purposes, and is being tried on the main lines. Several heavy oil-electric locomotives of 500 b.h.p., completely Japanese-built, were put into local freight service in the Kobe district. The steam locomotive stock increased by over 100 during the year, mainly by the addition of the standard three-cylinder Pacifics and two-cylinder Mikados.

Modern Refrigerating Plant Installed in Brewery at Shanghai

THE Union Brewery, Ltd., Shanghai, has put into service a new brewery, which is equipped with the most up-to-date machinery and can claim to be the largest brewery in China. The brewery is equipped to produce 6,600,000 galls. of beer per annum, and consists of a number of reinforced concrete buildings, viz.: a nine-story cellar building, a brewhouse, an engine and boiler house, a bottle filling and bottle cleaning building, a bottle storage house, a workshop and an office building, the latter containing also the quarters for the foreign staff.



View of the Union Brewery at Shanghai

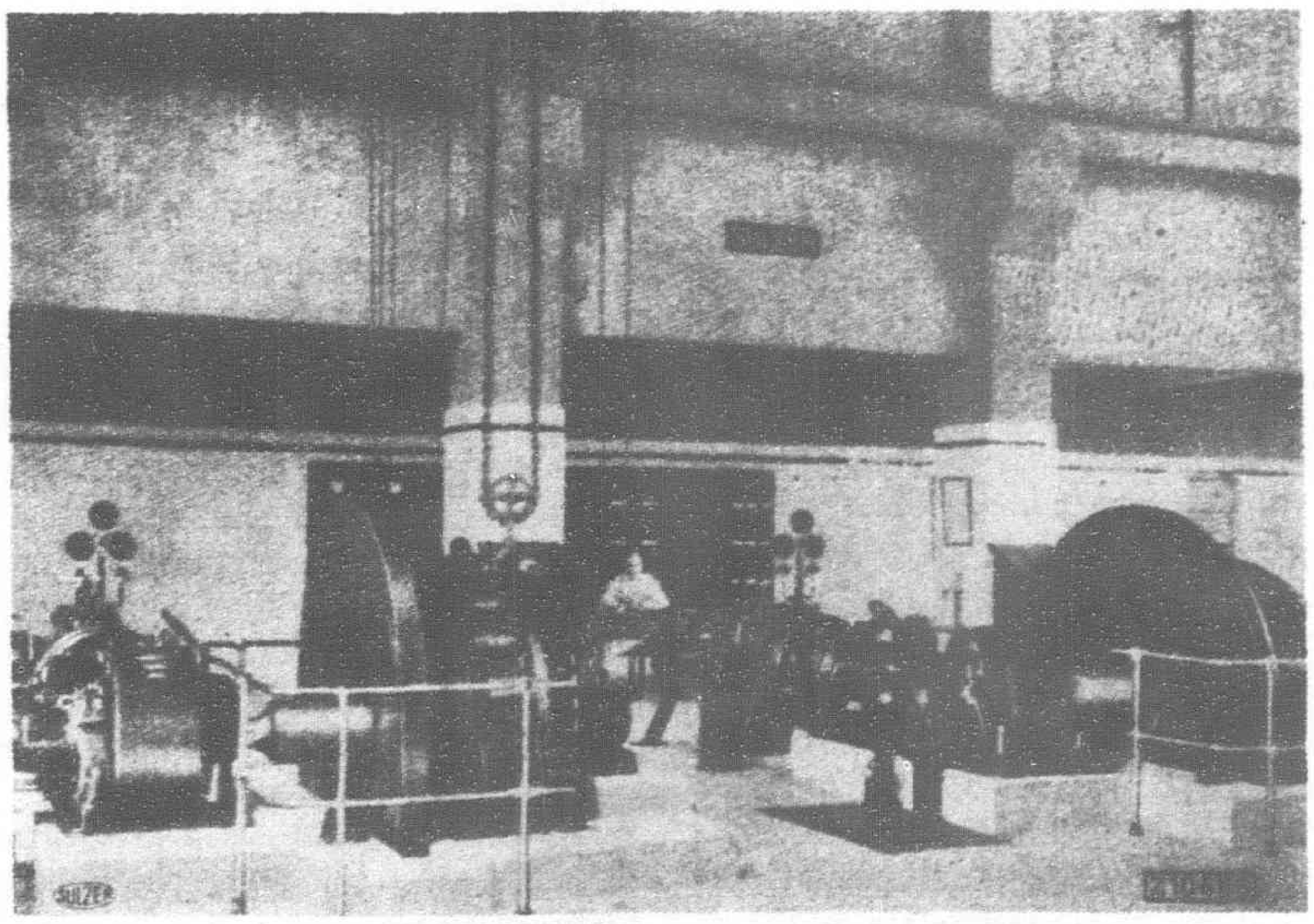
The order for the refrigerating plant was passed to Sulzer Brothers. This plant comprises two horizontal two-stage ammonia compressors, each with a refrigerating capacity of about 1,080,000 B.Th.U./h. at a temperature of evaporation of the ammonia of 9° F., and a temperature of liquefaction of 104° F. Each compressor is direct coupled to a Brown-Boveri synchronous motor and requires about 160 b.h.p. when running under the above-mentioned conditions. The condenser is of the Sulzer high-efficiency multi-tubular type and consists of separate elements which can be connected together in various ways to suit the prevailing conditions.

The cooling-water required for the refrigerating plant is taken from wells equipped with Sulzer borehole pumps.

The brine coolers are of the shell-and-tube type. Two units are installed, each comprising an inner nest of tubes in which the brine to be cooled circulates, and also an outer shell. The tubes are expanded into the ends of the shell, which are closed by covers shaped in such a way that suitable circulation of the brine is assured. The coolers are lagged with insulating material of ample thickness, so that the loss of cold is practically negligible. The brine is cooled down to about 27° F.

An electrically-driven Sulzer brine pump of the centrifugal type supplies the cold brine to the lower part of the wort cooler, whilst another pump of the same capacity sends cold brine to the pressure tank room in the bottle-filling building.

Three pumps, one of which is spare, deliver cold brine to the different air coolers and the cold fresh-water tank. After having passed through the different cooling systems, the warmed brine is collected in a tank situated on the third floor of the cellar building, from where it flows back to the two coolers.



Machine room of the Union Brewery, Shanghai, with two Sulzer ammonia compressors, each with a refrigerating capacity of 1,080,000 B.Th.U. at a temperature evaporation of 9° F. and a temperature of liquefaction of 104° F.

Next to the two brine coolers, a well-insulated fresh-water cooler, with a capacity of about 33,000 galls., is installed; in it the water is cooled down to about 32° F. Four vertical electrically-driven agitators assure good circulation of the water in the tank.

Two electrically-driven pumps, one of which is spare, supply cold water to the upper part of the wort cooler; two other pumps, one of which is also spare, deliver cold water to the cooling coils in the fermenting tanks.

Brine coolers, fresh-water cooler, brine and fresh-water pumps are located in a room on the ground floor of the cellar building next to the compressor room.

Several air coolers have been installed. Each cooler contains coils through which cold brine circulates, and is combined with a Sulzer fan driven by belt from an electric motor. One air cooler supplies the cold air for the beer storage cellars, the barrel-filling cellar and all the ante-rooms on the first, second and third floors of the cellar building. A second air cooler serves for cooling the hop cellar, whilst a third cools the fermenting cellar, the preparing room for the fermentation, the yeast growing and washing rooms, and the room in which the wort cooler is installed. This last cooler is combined with one filter for the circulated air and another for the fresh air, so that only sterilized air enters the room, thus eliminating any danger of infection.

One of the storage cellars is equipped with Rostock tanks. The beer in these tanks is cooled by means of cold alcohol circulating in coils. Two electrically-driven alcohol-water pumps, one of which is spare, assure good circulation in the cooling coils. An alcohol-water cooler with automatic temperature control is installed in the ante-room on the first floor in front of the Rostock tank cellar. The alcohol-water is cooled by direct expansion of ammonia. Other storage cellars are equipped with enamelled iron tanks.

In addition to the complete refrigerating plant with motors, air filters and insulating material, Sulzer Brothers also supplied and erected two borehole pumps. One of these pumps is situated in the compressor room, the other in a separate house in the courtyard. The first of these pumps delivers about 500 galls. per min. against a total head of about 296-ft., the power absorbed being about 67 h.p. The second pump supplies about 700 galls. per min. against the same total head and absorbs about 91 h.p. Both pumps are direct coupled to electric motors, operated automatically by means of a float switch installed in a tank on the sixth floor, to which the pumps deliver the water. From here, part of the water flows by gravity through the condenser and then back into a tank on the third floor, from where it is taken for use in the brewery for general purposes.

Reinforced Concrete Telegraph Poles as Used in Johore

By *A. H. CARSON*, *A.M.I.E.E., M.I.RAD.E.*

(From the Journal of The Engineering Association of Malaya)

In the early days of Telephone development in Johore, an extensive skeleton tele-communication system was required urgently for Administrative and Police purposes, and to this system the public were invited to become subscribers. It was not known at that time to what extent the public demand for communication facilities would increase, and it was therefore considered desirable to construct the original line system of a semi-permanent character using wooden poles. These poles were of local hardwood, cut from logs, usually Balau or Chengal, of square section, and were treated with preservative to resist the attack of termites and other destructive agencies.

With the passage of time the wooden poles, which had served the purpose for which they were originally intended, were not only unable to carry the loads imposed upon them but had decayed to such an extent that the replacement of a large proportion of them became imperative. It was also evident that within a few more years almost every pole in the system would have to be replaced either by new wooden poles, or by poles of a permanent type.

Concrete poles have been used extensively in Europe and America and authorities in these Countries have expressed varied opinions as to their suitability. From a perusal of their reports it is evident that such poles suffer seriously by comparison with others in one respect only; that is their inability to withstand successfully the rigorous conditions imposed in these countries by the wide variations of temperature between summer and winter. Malaya is not subject to climatic extremes, and in consequence, local conditions are favorable for the use of concrete poles.

Several advantages are to be gained by the adoption in this Country of concrete poles, the principal of these being their low initial cost. A further saving can be effected by casting suitable arm slots in them during manufacture, thus avoiding the need for expensive brackets for fixing cross arms. As it is not necessary to paint these poles, maintenance and upkeep costs are negligible. They can be seen clearly in the head lights of cars at night thus providing a rough guide to motorists of road width limits and direction.

The disadvantages which must be considered in connection with their choice are due to their relatively heavy weight which renders handling, transport, and erection more expensive than it would be in the case of sectional tubular iron poles. They are not so strong as well designed iron poles, yet they are strong enough for the purpose for which they are used, and as telephone lines, as opposed to power lines, are always stayed, even at slight angles, this disadvantage is not of great importance.

Each of these types therefore possesses distinct merits, but it was decided, on the ground of the considerable over all savingwhich could be effected, not only to standardize reinforced concrete poles for use in Johore, but to manufacture them departmentally. At the end of 1934 when it was decided that complete reconstruction of the pole lines throughout the State was desirable, it was estimated that 16,000 poles would be required for the replacement program, 4,000 for the normal extension and development of the system in 1935 and 1936, and a further quantity for stock against future demands.

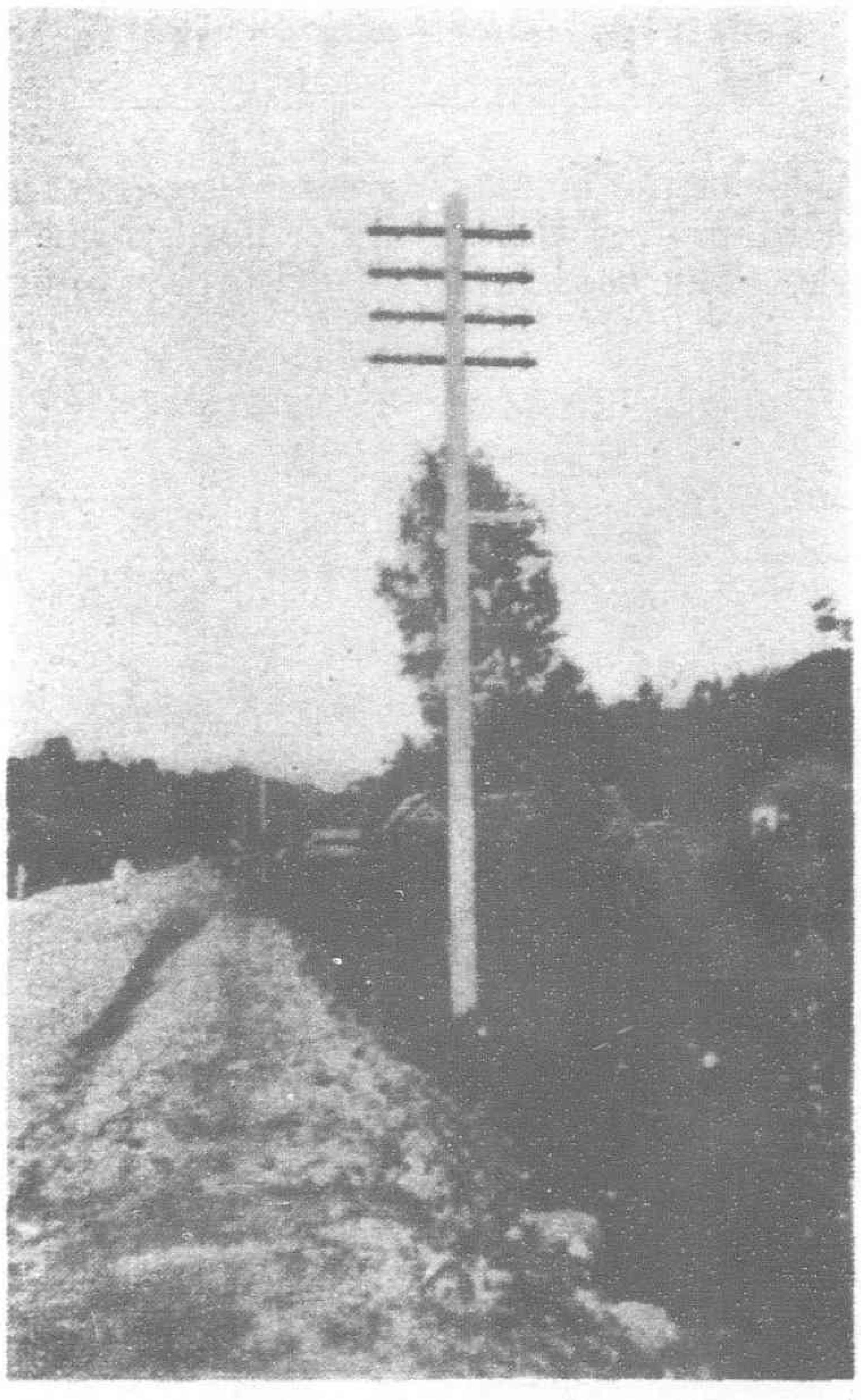


Fig. 1—Line of concrete poles near Pontian

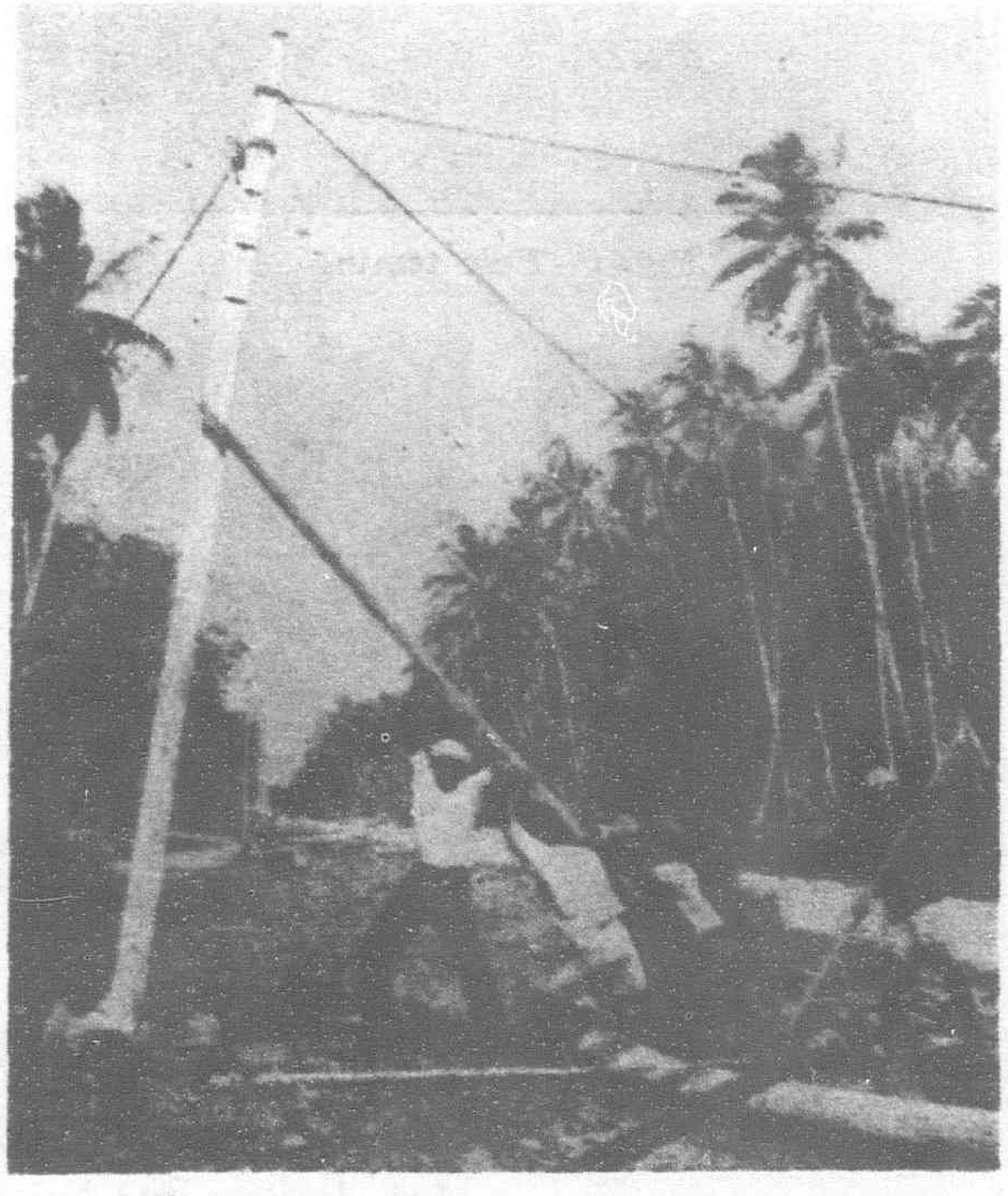


Fig. 2—Erecting 25-ft. concrete pole

The P. and T. Department in Ceylon had experimented with concrete poles for several years and had finally standardized a design which was found to be extremely satisfactory. The author was fortunate in being permitted to study the Ceylon designs and methods of manufacture, and to examine and test poles which had been in use in varying conditions for long periods. As a result of this experience it was decided to standardize the same basic type of pole in Johore, with slight modifications.

Manufacturing Depots

Two manufacturing Depots were established, one at Tampoi near Johore Bahru to serve South Johore, and the other at Muar to provide poles in the Northern half of the State. The sites for these Depots were carefully chosen having regard to all the circumstances connected with the availability and transport of raw material, and the ultimate dispatch and carriage of the finished articles by road or river. The normal monthly output of the Tampoi Depot is 550 poles, and of Muar 350, so that a total of 900 poles can be turned out each month. In addition to poles, several other articles are made, such as stay plates, base plates, stay markers, and cable covering slabs. In these places the work has become an industry in a small way and has thus benefited the local communities quite considerably.

Design of Poles

The poles are square in section but have chamfered edges. This not only improves their appearance but also renders handling much easier than it would be if they had sharp edges. They taper slightly from the base to the top as indicated in the following table of dimensions. Suitable slots and bolt holes for fixing cross arms are cast in them. The size of each pole, year of manufacture, and the Departmental crest are cast on the side of each one manufactured. The crest is cast at a point 10 feet from the base as a means for checking the depth to which poles are planted.

Moulds

The moulds in use are made of Balau or Chengal cut from selected wooden poles which were previously in use for six or seven years. This wood was therefore thoroughly seasoned and no trouble has been experienced from

Schedule of Data for Reinforced Concrete Poles

Length Ft.	Dimensions of sides (inches)		Weight lb.	Spiral Reinforcement No. 11 Fe.			Bar Reinforcement			No. of Arm Slots	Bending moment in foot lb. at ground line	Breaking stress in lb. applied at center of loading line
				Diameter (in.)		No. of Turns	No. of Bars	Length Ft. In.	Cross Section Inches			
	Top	Bottom		Top	Bottom							
18′	3½″	5¼″	430	2″	3¾″	54	4 2 2	17′ 10″ 7′ 6″ 4′ 00″	¾″ × ¼″ ⅜″ round do.	3	7,500	525
20′	3½″	5½″	510	2″	4″	60	4 2 2	19′ 10″ 9′ 00″ 4′ 6″	¾″ × ¼″ ⅜″ round do.	4	9,000	560
22′	4½″	7″	800	3″	5½″	66	4 4	21′ 10″ 9′ 00″	1″ × ¼″ ¾″ × ¼″	6	13,200	820
25′	4½″	7½″	980	3″	6″	75	4 4	24′ 10″ 12′ 00″	1″ × ¼″ ¾″ × ¼″	6	16,000	770

warping. The inside sections of the base and sides of the moulds have been covered with 1/16-in. galvanized iron to protect them, and to provide a good clean finish for the poles. The bases are mounted on small concrete pillars at a suitable working height and the detachable sides, when assembled, are keyed together by cross pieces as shown in figure 3.

Although four lengths of poles are made, i.e. 25-ft., 22-ft., 20-ft. and 18-ft., only two types of moulds are used. These are 25-ft. and 20-ft. respectively, and when the shorter types of poles are to be made, blocking pieces are fixed in the moulds at appropriate distances from the base end of each.

Reinforcement

The reinforcement is formed by winding a length of No. 8 S.W.G. iron wire on a suitable revolving former to make a conically shaped spiral of a predetermined number of turns. This spiral is next laid on a bench and is stretched over spacing pins to set each turn equidistant from the next, and to stretch the spiral to a suitable length. While the wire spiral is still fixed to the spacing pins the first reinforcing bar is fitted to the outside of it by means of loop clips of No. 11 S.W.G. iron wire. When the first bar has been firmly clamped to the spiral throughout its length a second bar is similarly fixed, and between these another two full length bars are attached in the same way. Finally four half length bars are clamped inside the reinforcement to provide greater strength from the base to a point well beyond the wind and water line, which, with a fixed pole, is a point of maximum strain.

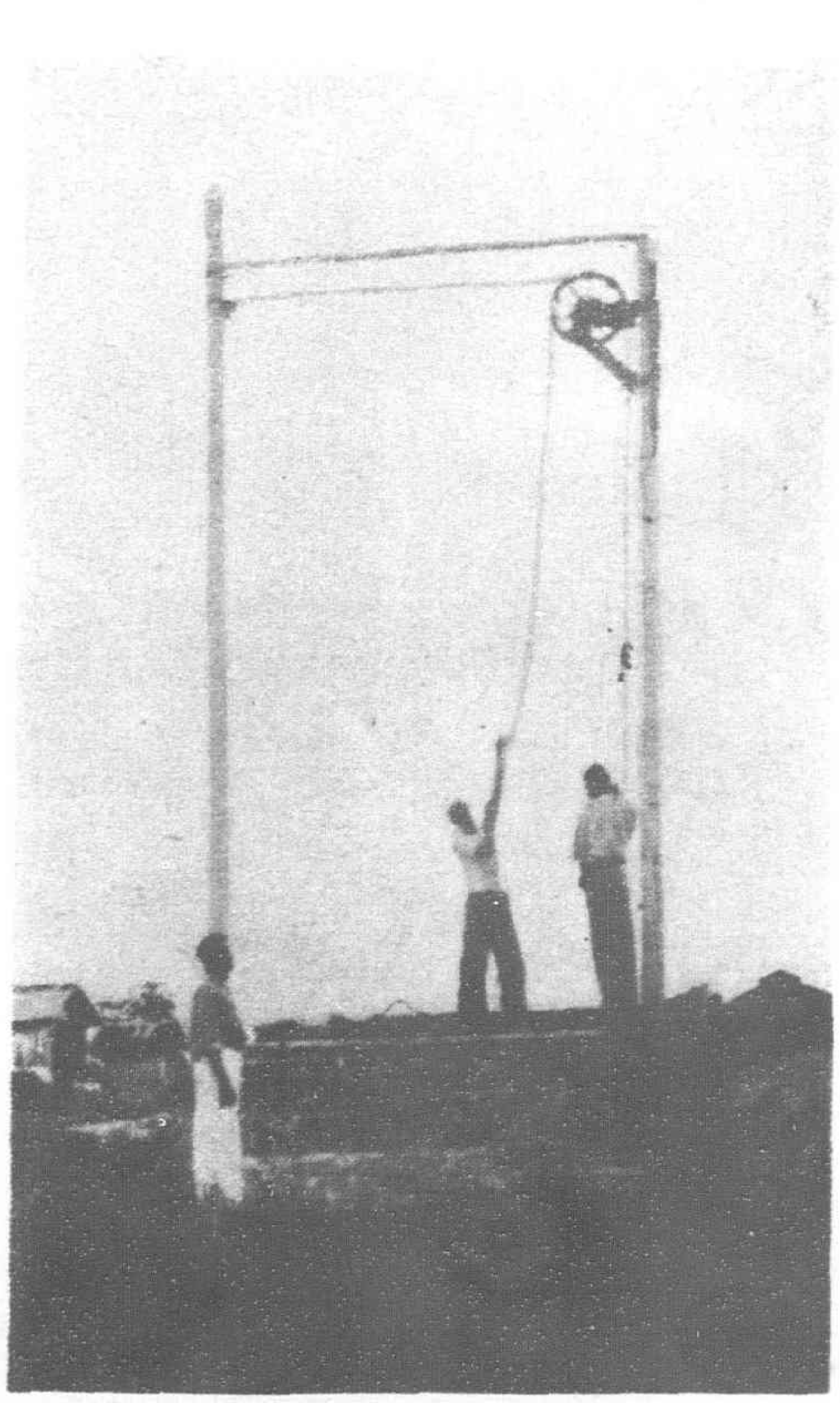


Fig. 5—Pole testing

Contrary to usual practice, the mild steel bars used are of flat section, and they are imported in suitable lengths to obviate cutting or any other treatment locally in preparation for use. For poles of the type under review, flat bars are more suitable than round ones as a greater coverage of concrete can be arranged over them. They also offer more resistance to the torsional stresses likely to be imposed on the poles due to uneven loading, or to other unequal stresses such as may be caused by tree branches falling on wires, or by wires breaking.

Concrete Mixture

The mixture which is used consists of one part cement, two parts of river sand and three parts of ½-in. or ¼-in. granite, according to the type of pole for which it is required. Rapid hardening cement is used as it has been found in practice that, although it is slightly more expensive initially, a considerable saving can be effected in the number of moulds in use, and in the space which would be required for additional moulds than if Portland cement were used. Yet another advantage which favors the use of this cement is that poles manufactured from it are ready for use much earlier than they would be otherwise.

Power driven concrete mixers are used and the mix is of a consistency which

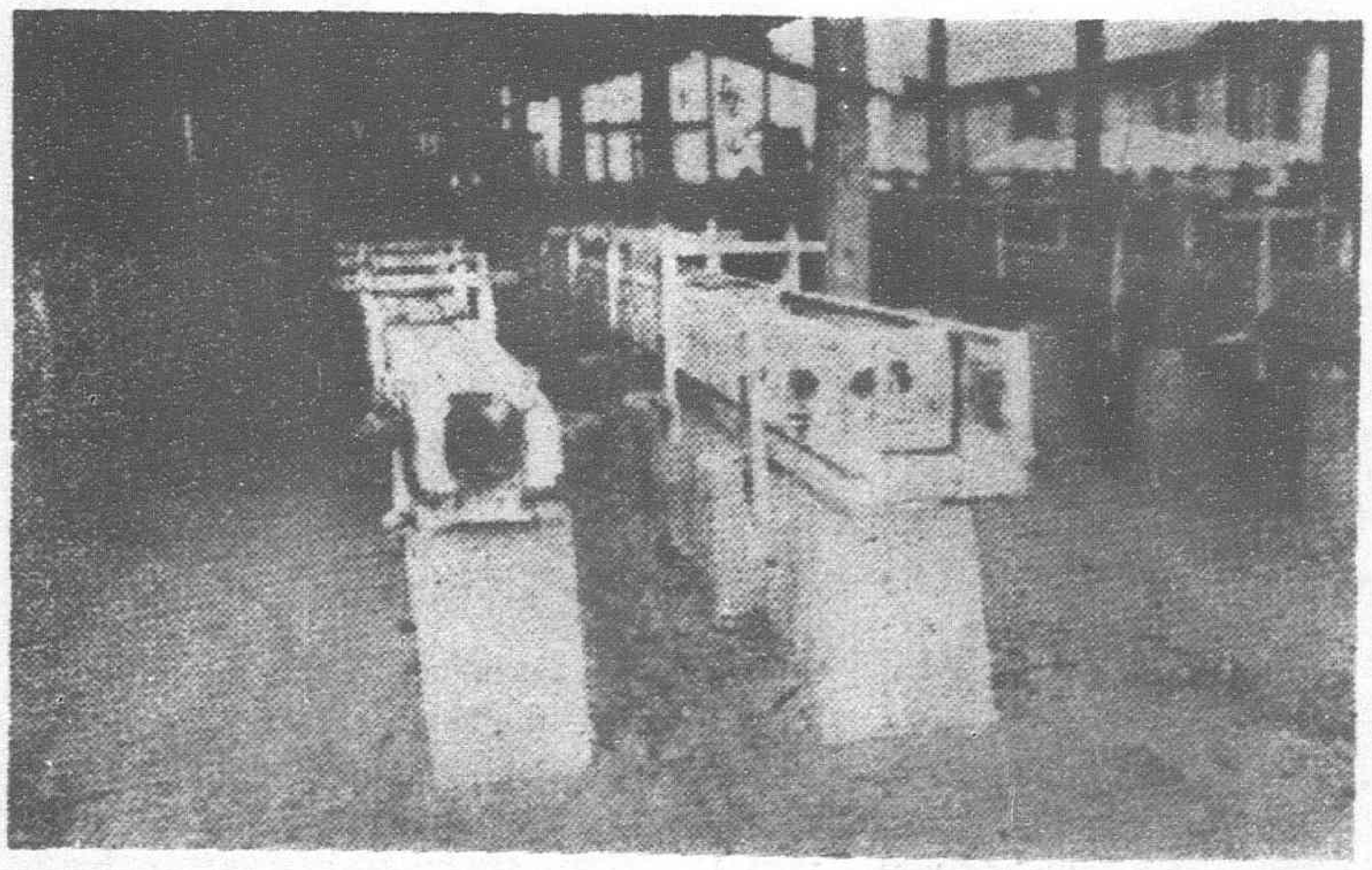


Fig. 3—Corner of moulding shop

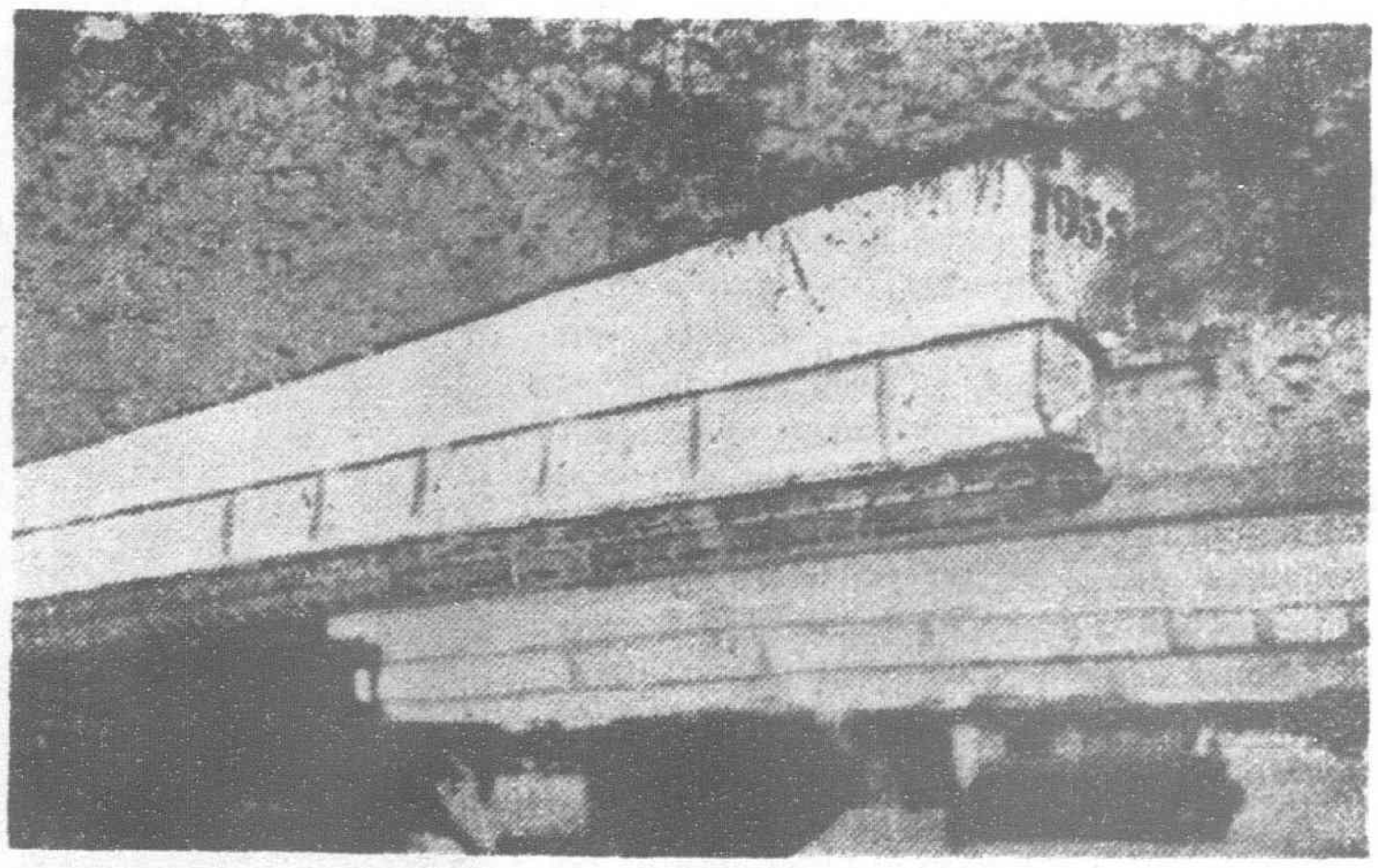


Fig. 4—Base and top ends of poles with reinforcements on top

permits the making of a good cast without serious loss of strength due to excessive moisture.

Casting

The reinforcements are placed in the moulds centrally, and while the concrete is being placed in position, and is being thoroughly tamped, the reinforcement is shaken in the mixture. This is done by means of a lever pivoted on an iron cross piece set across the mould. This cross piece also acts as a gauge as it is fitted with a lip ¾-in. deep which when in use ensures that the reinforcement will be covered all round to that extent. At this stage bolt holes are also cast by fixing suitably sized bolts through the moulds where required. These bolts are removed after one day, but the poles remain in the moulds for three clear days.

Curing

As no elaborate curing installation such as a steam plant or permanent curing tanks is available, the poles are laid out in show pits which fill with water. They are kept in these pits for a period of three weeks after which they are kept moist under damp earth for a further period of two weeks. They are then stacked and air dried before being dispatched for use.

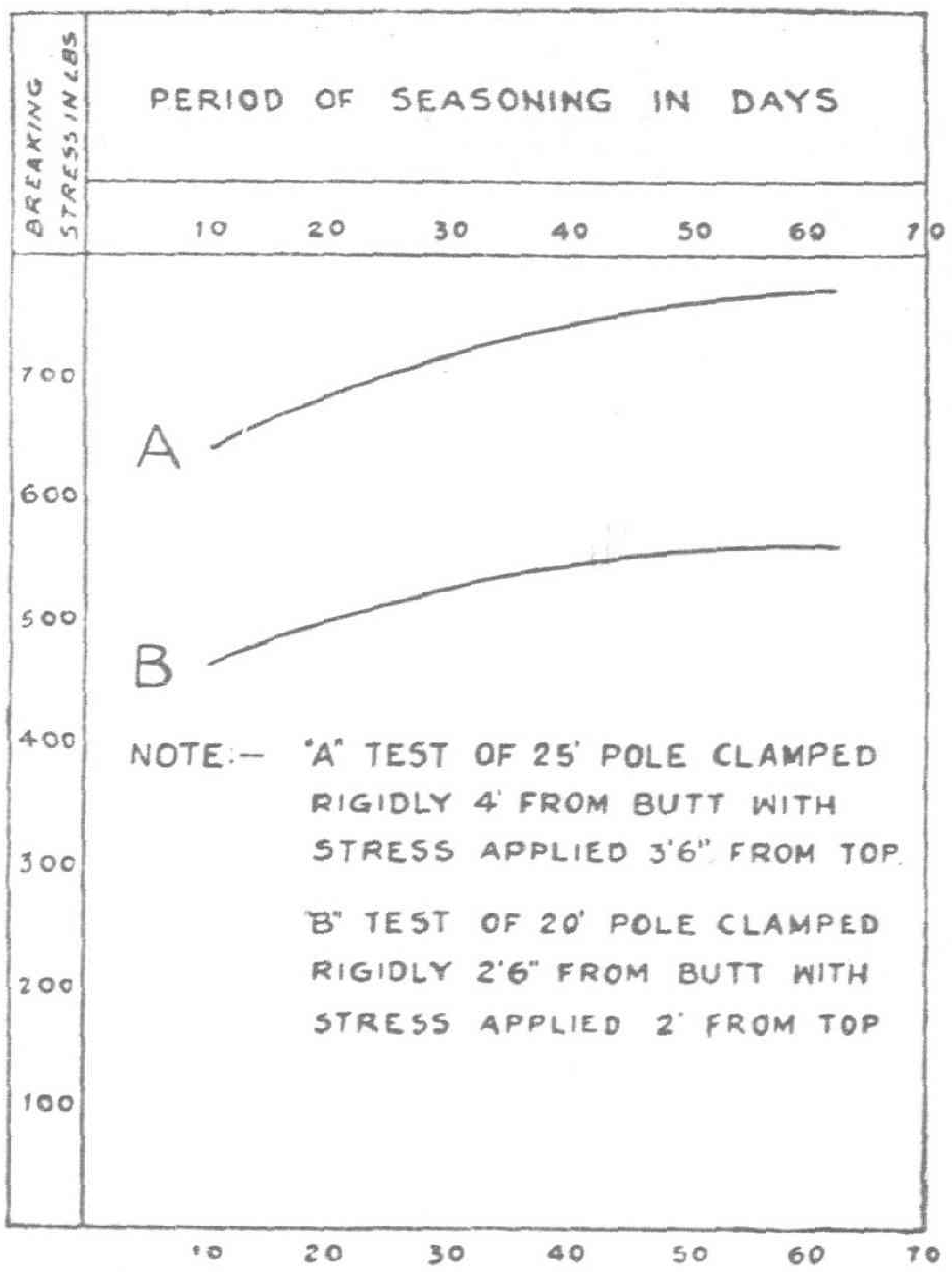


Fig. 6

Testing

Pole testing under standardized conditions is considered essential for comparable results to be obtained and with this end in view poles of different batches, and poles of single batches but of varying ages, are tested. From the data so obtained the minimum curing and loading time factors have been determined and a check is thus kept on the quality of the material used and in the standard of manufacture.

The method of testing is clearly shown in figure 5, in which it will be seen that the poles to be tested are rigidly clamped in a vertical position against a concrete base for a length corresponding to their setting in actual load conditions. On the opposite side of this concrete base stands a stout pole which is so rigidly stayed against the strain imposed in testing conditions as to render it immovable throughout any part of its length. To this rigid pole is fixed a grooved pulley, with ball bearings, which is adjustable in height to suit the pole being tested. A bar with a scale graduated in inches is fixed to the permanent pole in such a position that it lies along the direction of strain of the pole under test, to indicate its deflection. A rope is fixed round the pole under test at a point which would be the normal center of strain in load conditions. This rope is passed over the grooved pulley on the permanent pole and hooks are attached to it on which weights representative of a working load can be suspended. With suitable weights slung in the hooks a direct reading can be obtained, on the graduated scale, of the deflection of the pole under load.

Another rope is slung over the pulley in the opposite direction, its free end being allowed to hang between the poles. This rope is used to release the testing weight in order to determine from the scale the permanent set of the pole after the load has been released.

The average test results of poles of various types are shown in schedule of data at the beginning of this article, and, in figure 6, is indicated graphically the extent to which a pole increases in strength during the curing process.

In connection with the reconstruction program difficulties have been encountered in the erection of these poles, due to their weight, particularly in swampy areas. Many trees had to be felled to provide adequate clearance for the lines. Existing wires had to be transferred and regulated on the new poles without interruption to service. The work is nearing completion and the thousands of concrete poles now in use in Johore will, it is anticipated, serve satisfactorily for many years.

England-Australia Marine Air Route

INTERESTING developments can now be recorded as to the plans which are in hand for operating Empire flying boats right through between England and Australia.

The other day the Imperial Airways "Cordelia" returned to Southampton after a flight as far as Singapore. The "Cordelia" had been engaged in a special survey of the marine air facilities that have been provided across India and eastward to Singapore, and was the first Empire type flying boat to make use of the new seaplane base at Singapore.

Within a day or so of the "Cordelia's" return, the Empire flying boat "Centaurus" left Southampton on a survey flight which will take this aircraft to Australia and on to New Zealand. It is reckoned that, by the time the "Centaurus" returns to England, a total distance of over 30,000 miles will have been flown. Her flight across the Tasman Sea to New Zealand will be the first commercial flying boat survey over this important route, and will represent a preliminary stage in the opening of a regular air service linking New Zealand with Australia and with the general system of Empire air-lines.

The preparations in hand for changing over from landplanes to flying boats between Singapore and Sydney was referred to by Mr. Hudson Fysh, Managing Director of Qantas Empire Airways, prior to his departure the other day on his return from England to Australia. Mr. Hudson Fysh has been spending a couple of months in England, arranging details of this change-over to marine aircraft. He mentioned that, following agreement between the Home Country and Australia for the provision of flying boat harbors in Australia, it was hoped to have sufficient equipment available for flying boats to be operating through to Australia early next summer.

Mr. Hudson Fysh added that, as soon as the England-Australia flying boat service was fully established, the "all-first-class-mails-by-air" scheme would be brought into operation on the route. An immediate result of the operation of flying boats to Australia would be the shortening of the time occupied by a Southampton-Brisbane air journey from 12 to 10 days; while further accelerations would become possible as facilities for night-flying were made available.

Apropos of the news above as to a survey flight from England to Australia and New Zealand, it is interesting to note that an important meteorological conference, attended by representatives of Great Britain, Australia, and New Zealand, is now in progress in New Zealand with a view to studying, and co-ordinating, weather reporting and forecasting in south and south-west Pacific zones.

Meteorological stations already exist in these regions, but from a flying view-point there is need for an amplification and extension of facililties; while it is also thought desirable to obtain further data as to the movements of typhoons, and as to general conditions as they would affect the operation of air services in the south and south-west Pacific.

The New Orient Line Steamer "Orcades"

Outstanding among recently built ocean vessels is the Steamer Orcades, built in the Naval Yard of Messrs. Vickers-Armstrong, Ltd., for the Orient Steam Navigation Company, Ltd. The vessel was launched on December 1, 1936, and in October last sailed on her first voyage to Australia. An interesting description of this new vessel appears in the August, 1937, issue of The Engineer and pertinent portions of this article are reprinted herewith as follows :

* * *

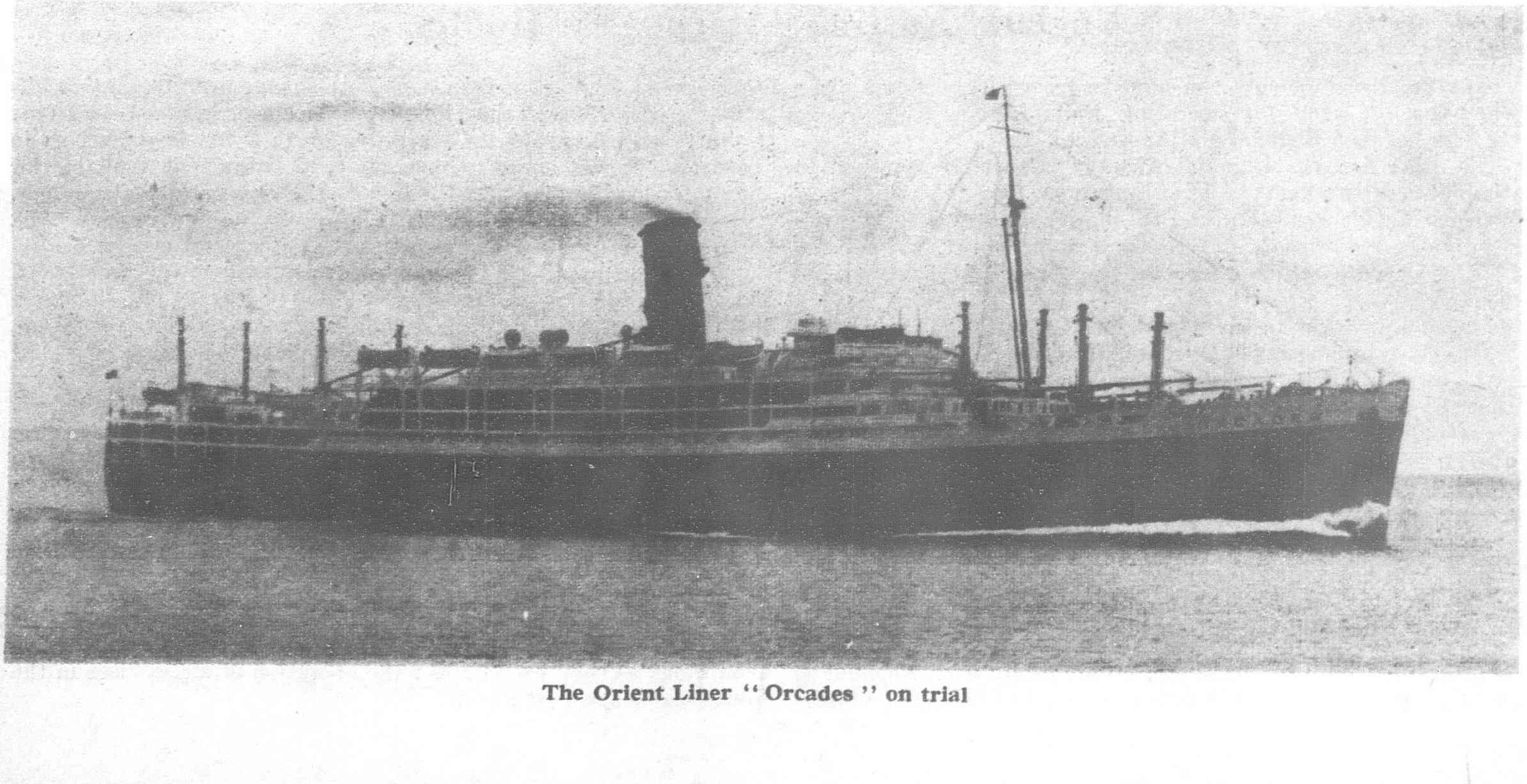
FROM the view of the ship on trial, reproduced herewith, it may be noted that the general appearance of the new liner differs but little from her sister ship the *Orion.* The distinctive features adopted in the *Orion* have been retained, such as the single forward mast and one funnel amidships. In the *Orcades*, however, the height of the funnel has been increased by about 9-ft. with the object of giving a freer flow for the gases, and a lessened tendency for the smoke to be carried down towards the decks. The coloring of the ship is the same as the *Orion*, and the green boot topping, with a corn-colored hull and white painted superstructures, make a very pleasing appearance. The length of the forecastle deck has been increased somewhat. A new feature, which is illustrated is the extended use of wider-spaced side stanchions in the way of the stern and for the covered promenade decks, which are of welded box form open on the inside. As they are much stronger than the stanchions formerly employed they can be spaced at wider intervals and give a less obstructed view from the decks. The principal hull dimensions and particulars are given in the table on p. 36. The ship has been constructed under the survey of Lloyd's Register of Shipping for the 100 A 1 class, and embodies the requirements of the latest Board of Trade rules and provision for safety at sea. The hull has a raked stem with a cruiser stern, and, including the superstructures, it is divided into eight decks, which are lettered from above to below from " A " to " H " respectively. There is a small " J " deck amidships, and an orlop deck in No. 1 hold forward. The subdivision of the hull embodies the latest Convention requirements, and includes ten primary watertight or oil-tight bulkheads which are carried up to the bulkhead of " F " deck. Safety is further assured by the provision of additional deep-tank divisions and the grouping adopted for the fresh water and oil fuel tanks in close proximity to the engine and boiler-room spaces. There is a cellular double bottom which is carried fore and aft, and is suitably divided for the necessary tank requirements. At the forward end of the double bottom a duct keel is formed.

Cargo is carried in three holds and lower 'tween deck spaces forward, and in three holds and a lower 'tween deck space aft. These after spaces are reserved for the carriage of general cargo, while the forward spaces are insulated for the carriage of refrigerated and chilled cargoes of perishable goods.

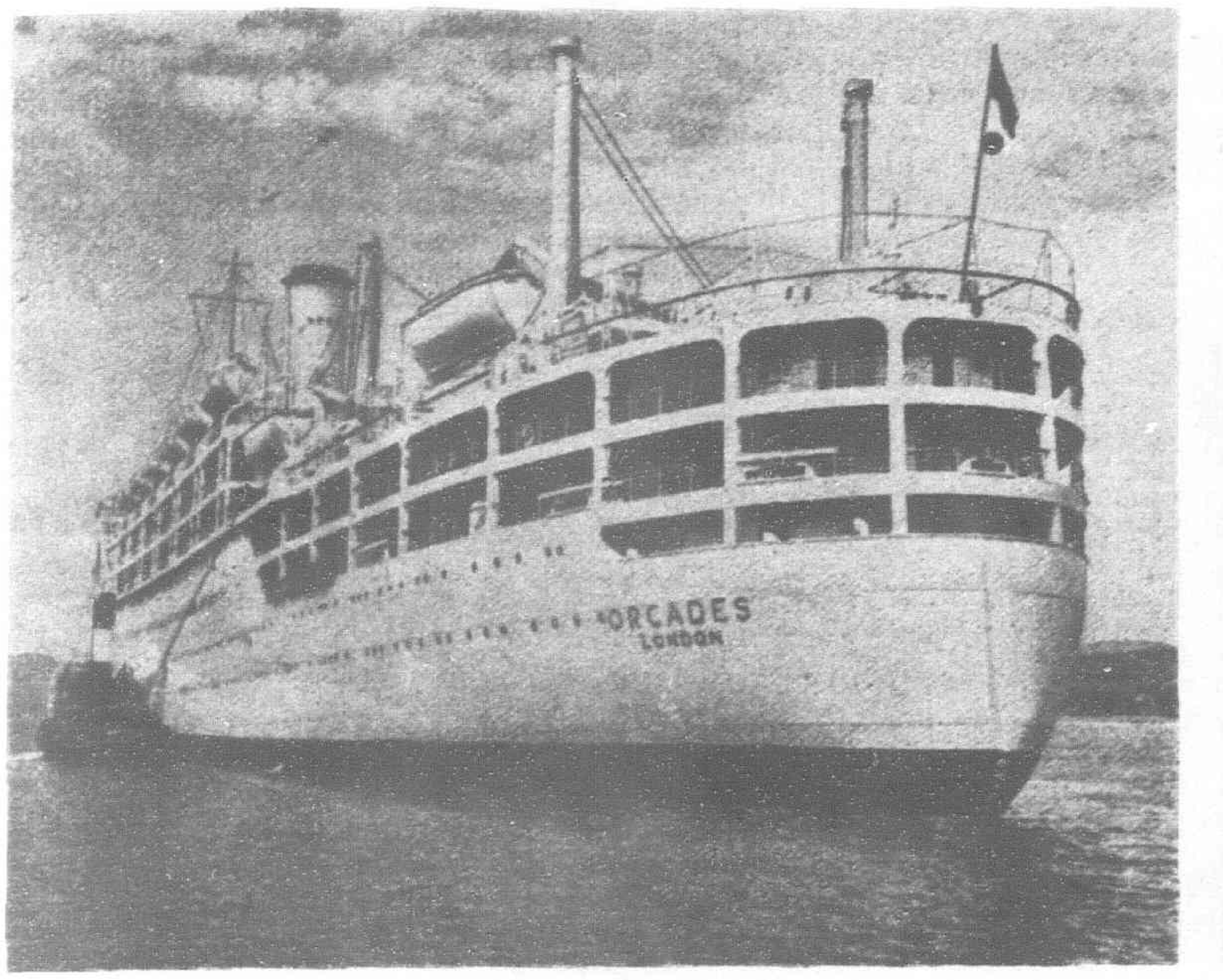
Deck and Other Auxiliary Machinery

The cargo is worked from steel derricks mounted on derrick posts, which are shown fore and aft in the accompanying illustration. A special 20 ton derrick is provided on the after side of the mast and serves No. 3 hatchway. All cargo winches are electrically operated and they comprise twelve single-barrel winches and six double-barrel winches, most of which are of the Metropolitan-Vickers type. The capstans and anchor windlass and also the two warping windlasses aft are of Napier Bros.' design, with the Austin single-unit system of drive. A Brown Brothers' four-cylinder electro-hydraulic steering gear is installed, driven by a Laurence-Scott motor. The lifeboat equipment was supplied by Hugh McLean and Sons, Ltd., of Govan, and the boats are built of " Armco " iron with integral buoyancy tanks. We noted that twenty lifeboats and two motor boats are carried, also two service boats. The main boats are carried in gravity type Welin-MacLachlan davits, complete with electrically operated boat hoisting winches. The all-electric watertight door system was designed and supplied by J. Stone and Co., Ltd., of London and Deptford, which firm also supplied the propellers described below, and over 360 special windows of the pressure tight spring-balanced pattern, also quick-lifting windows and rack and pinion windows, etc. The Stone all-electric system for controlling the watertight doors operates the two vertical doors fitted in the tunnel recess, also one vertical door fitted in the bulkhead between engine-room and boiler-house. It is operated from the bridge and an indicator on the bridge shows when doors are open or closed.

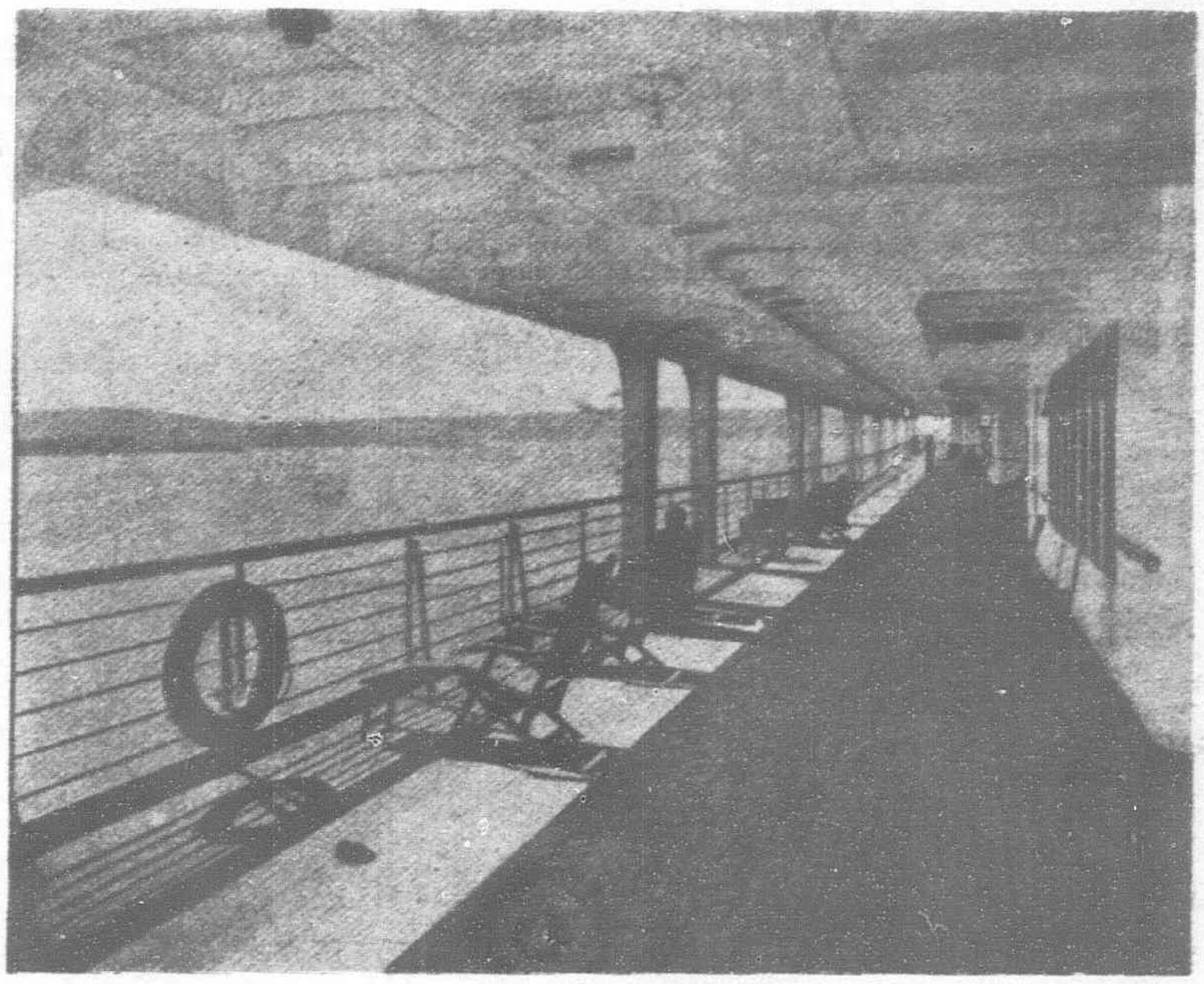
One of the ingenious arrangements incorporated in the doors is a lever linkage system of simple construction, which provides a mechanical advantage when most required, i.e., when a door is to be opened and consequently drawn from the grip of its wedges. It operates as follows :—On the screwed shaft which actuates each door there is a bronze nut working in a rectangular cavity which allows the nut to move up and down the screwed shaft within controlled limits. To this nut are attached two levers in the plane of the door and pivoted to the door panel ; their outer extremities swing clear of the door panel and can make contact with stops on the door frame. Thus when a door is to be opened the electric



The Orient Liner " Orcades " on trial



Stern view



Promenade deck

motor operating the door starts up light, turning the screwed shaft and lifting the nut which in turn rotates the levers about their pivots. Meanwhile the door has not moved, but after a certain travel of the nut the levers made contact with the stops and the door is levered out of its wedges. Immediately after this the nut makes contact with the end of its container and the door lifts at full speed. When closing, the pressure exerted by the screw is transmitted to the door through a buffer spring below the nut. There is also a device fitted whereby, when a predetermined load has been applied to the door when closing or striking an obstruction anywhere in its travel, the motor is switched off to prevent burning out. However, should the obstruction be of a yielding nature, the motor will again be automatically switched on and the door will automatically follow through.

In the lower part of the ship are horizontal sliding watertight doors by John Broadfoot and Sons, Ltd., of Whiteinch, and some special hinged steel watertight doors, by Mechans, Ltd., of Scotstoun.

Navigating Instruments and Equipment

The navigating bridge deck is arranged over the forward end of " A " deck and it includes a roomy wheel house and chart room. Among the instruments we noted a Kent clear-view screen and Huson magnetic compasses with a full equipment of Sperry gyrocompass gear for automatic steering and course recording, with all the usual repeaters. The engine-room and docking telegraphs are of Chadburn pattern, and intercommunication is facilitated through loud-speaking telephones of the T.M.C. pattern. There is a Barr and Stroud range finder and a Marconi " Echometer " sounding device. The Marconi Company also supplied the main wireless equipment and direction finder, and the wireless transmitter and receivers for two of the lifeboats. The Marconi sound reproducing equipment has been installed, together with sixteen loud-speakers, which can be employed to relay speech or music and to broadcast items to different parts of the ship ; a broadcast receiver for picking up land stations is provided.

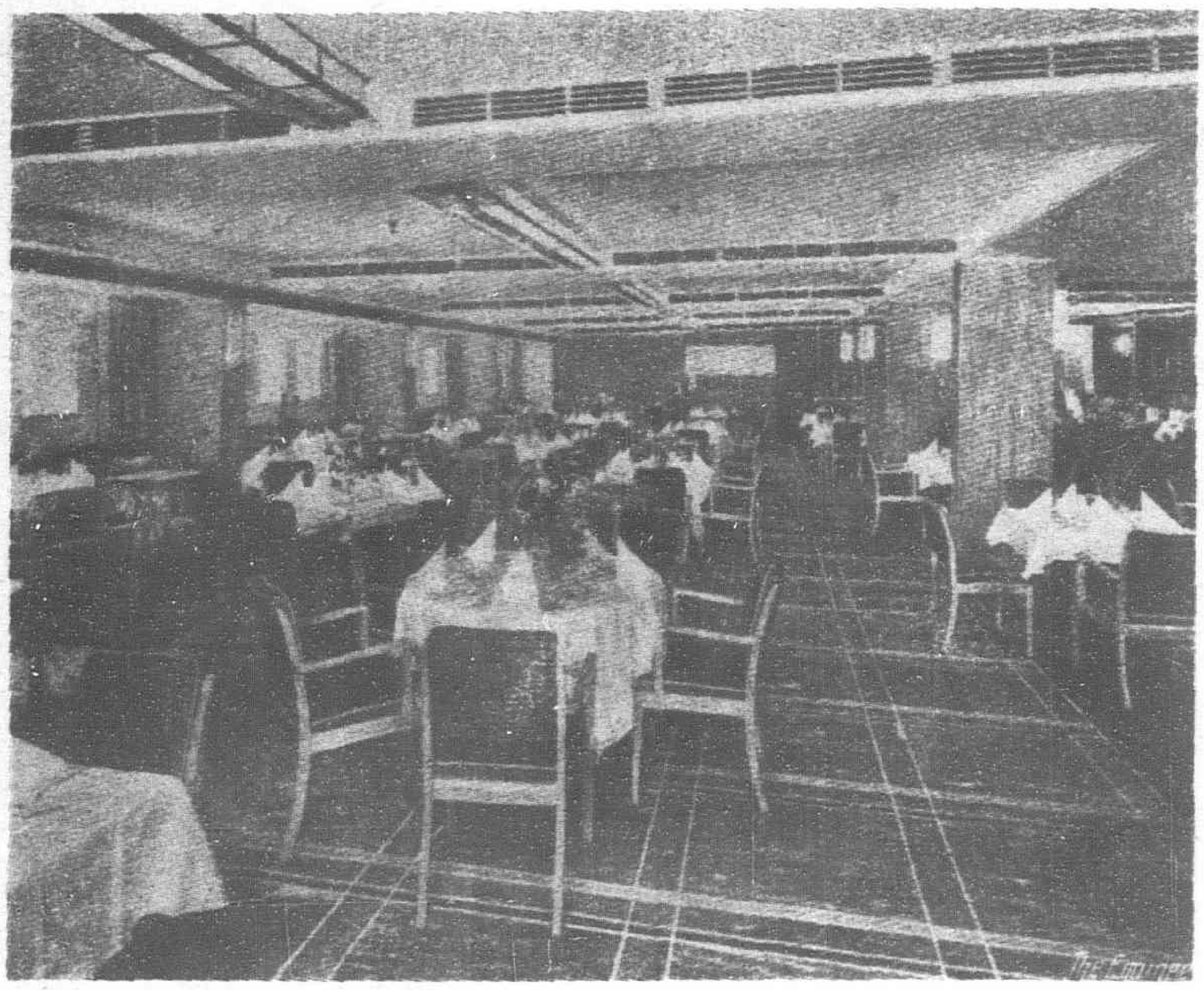
Fire Protection, Heating and Ventilation

In addition to the usual provision of fire-proof bulkheads and doors, and hand extinguishers, the principal public rooms and cabin spaces are protected with the Mather and Platt sprinkler system. For the cargo spaces and store-rooms the Richaudio system of fire detection has been installed by the Walter Kiddie Company, Ltd., of London. In connection with the engine and boiler rooms, foam equipment has been supplied by the Pyrene Company, Ltd., of Brentford, Middlesex. The heating and ventilation system was designed and supplied by the Thermotank Company, Ltd., of Govan, Glasgow. For supplying conditioned air to the public rooms and some of the cabins a special plant was constructed by the Carrier Engineering Company, Ltd., of Buckingham-gate, London. This works in connection with the refrigerating and cooling equipment supplied by J. and E. Hall, Ltd., of Dartford.

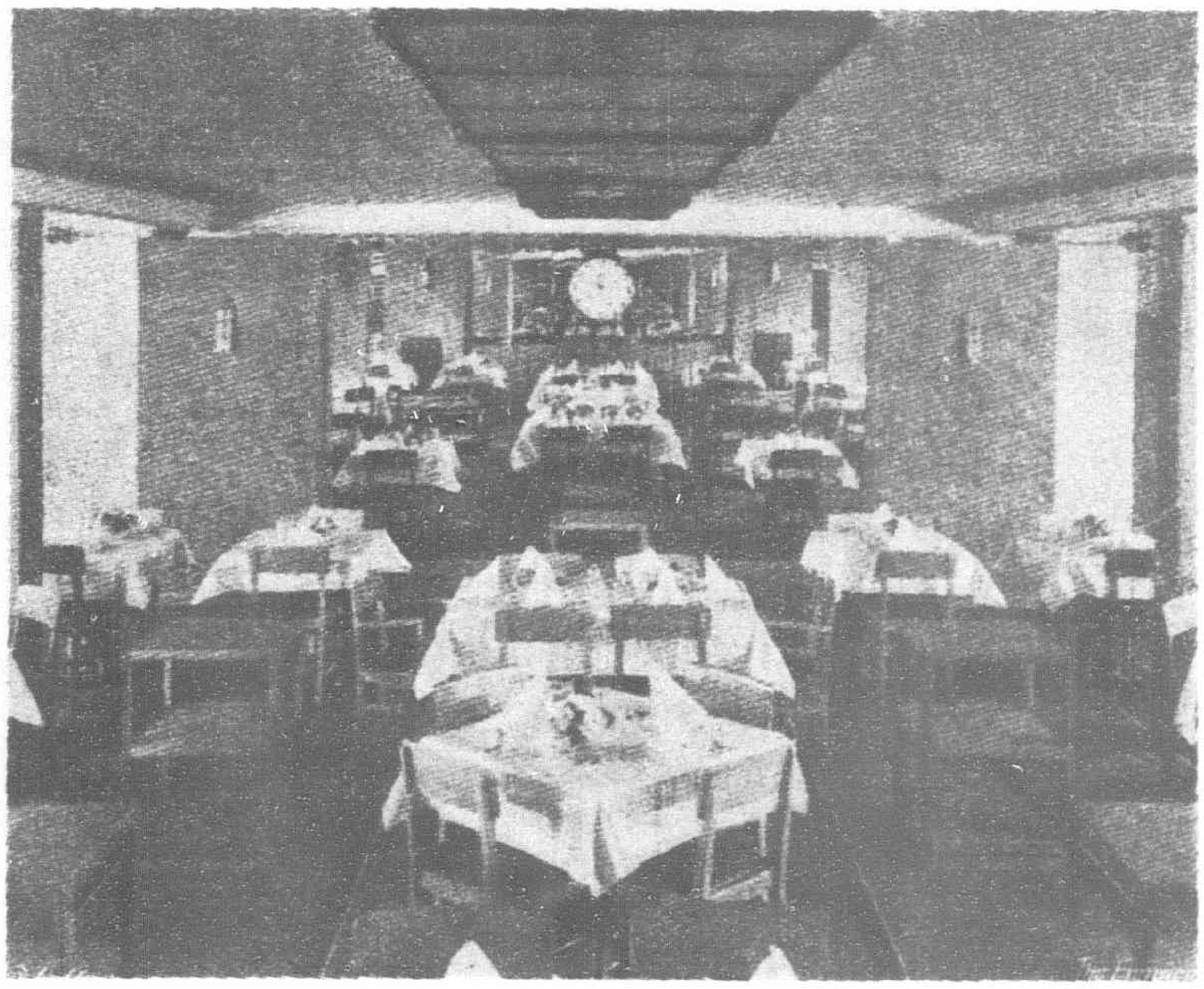
Passenger Accommodation

The whole of the work for the public rooms and the special cabins was, like that for the sister ship *Orion*, entrusted to the company's architect, Mr. E. Brian O'Rorke. In carrying out this work a successful attempt has been made to carry still further the idea that the lines of a ship should give all that is required as a basis for decorative design. We observed that in all cases the lines of the ship's steel have been followed as closely as possible and that such items as vent trunks and grilles have been used frankly as part of the decoration and have not been concealed or disguised. The planning has resulted in lending a feeling of spaciousness throughout the ship, which has been helped by adopting large window areas in the various deck houses. A pleasing and artistic effect has been gained by the extended use of decorative woods, many of which are of British origin. The contractors for the panelling and decoration of the first-class rooms and staircases were H. H. Martyn Co., of Cheltenham. The first-class dining saloon is generally similar to that of the *Orion*, but an innovation is the addition of two auxiliary rooms forward, which are divided from the main room by glazed screens and curtains, so that they can be used as children's or private dining rooms. The space forward of the dining saloon serves as a *foyer* and also the main entrance to the ship, the passenger lift and the stairway giving access to the decks above. On " E " deck is the space reserved for ship's notices, and above on " D " deck is the shopping center, and behind the shop the hair-dressing saloon, which is air conditioned. On " C " deck are writing spaces and on " B " deck a hall leading to the library and the lounge. The library is air conditioned. The lounge occupies a central position and through it, going aft, the dancing space is reached, which can be shut off to form a cinema or entertainment hall or used as an open deck space. On the other side of this space a café and bar is provided. Below on " C " deck is the tavern which looks out on to the promenade and sun deck with the two swimming pools for first and tourist-class passengers.

The special first-class cabin accommodation comprises two air-conditioned " flats," each with sitting room, bedroom and bathroom, hall, trunk room, and kitchenette ; four large double bedrooms, 18-ft. by 11-ft., also air conditioned, and twelve other double cabins, each with private lobbies and bathrooms and with furniture and fittings specially designed by the architect. Forward on " C " deck is the nursery with its own play deck. The Orient tradition for large deck spaces is fully realized in the *Orcades* for both classes of passengers. The tourist accommodation follows closely the general simple line adopted for the first-class public rooms. There is a large tourist lounge, a café, and children's play room. The contractors for the public rooms and special cabins in the tourist class were Hampton and Sons, Ltd., of London.



First-class dining saloon



Tourist class dining saloon

Propelling Machinery

The vessel is propelled by twin screws, driven by two sets of Parsons turbines, through single-reduction gearing. Each set comprises one high-pressure, one intermediate-pressure, and one low-pressure turbine, working in series and driving separate pinions engaging with the main gear wheel.

The high-pressure turbine is of the impulse-reaction type, the first stage consisting of an impulse wheel with two rows of blades, and the remainder of this turbine comprising six stages of reaction blading mounted on a hollow drum of forged steel.

Hull Dimensions and Particulars.

Length overall	665-ft
Length between perpendiculars	630-ft.
Breadth overall at "C" deck	84-ft.
Breadth moulded	82-ft.
Depth moulded to "C" deck	63-ft. 6-in.
Depth moulded to "E" deck	47-ft. 6-in.
Depth moulded to "F" deck	38-ft.
Displacement tonnage	28,400
Gross register tonnage	23,400
Draught moulded	30-ft.
Total normal shaft horse-power	24,000
Designed service speed	21 knots

Passenger Accommodation.

Number of first-class passengers	463
Number of tourist class passengers	605
Number of Ship's working complement	466

Propelling Machinery.

Type, Twin-screw single-reduction Parsons geared turbines	
Designed service output	24,000 s.h.p.
Astern power	70 per cent of ahead power
Turbine speed	1,715 r.p.m.
Propeller speed	112 r.p.m.

Boiler Installation.

Type of boilers	Babcock & Wilcox oil-fired
Number of boilers	Four large and two small
Designed working pressure superheater outlet	425 lb./sq. in.
Safety valve blow-off pressure	450 lb./sq. in.
Large boilers:	
Total generating surface	29,860 sq. ft.
Total superheating surface	4,600 sq. ft.
Total air heating surface	32,000 sq. ft.
Small boilers:	
Total generating surface	7,170 sq. ft.
Total superheating surface	1,350 sq. ft.
Total air heating surface	8,000 sq. ft.

Turbo-generator Sets.

Type of generating plant	Allen D.C. turbo-generators
Number of sets	3
Total designed output	1,650 kw.
Turbine speed	5,000 r.p.m.
Generator speed	500 r.p.m.
Voltage	220-volts

Emergency Generator Set.

One 90-kw. Allen oil engine-driven set

The intermediate-pressure turbine is of the reaction type, having seven stages of blades mounted on a hollow forged steel drum; while the low-pressure turbine is of the single-flow type, having sixteen rows of reaction blading mounted on forged steel disc wheels.

The astern turbines consist of one high-pressure and one low-pressure turbine, working in series. The h.p. astern turbine is incorporated in the intermediate cylinder, and comprises one impulse three-row wheel. The low-pressure astern turbine, which is incorporated in the L.P. casing, consists of one two-stage impulse wheel, followed by five stages of reaction blading.

The rotor shafts of all the turbines are packed with both labyrinth and carbon packings, and "Michell" type pivoted adjusting blocks are fitted. All the turbines are designed to run at 1,715 r.p.m., and the gear ratio is such that with this turbine speed, the propellers run at 112 revolutions. The total shaft horse-power developed on trial by the two sets of turbines at the speed named was 24,000, the power developed astern being approximately 70 per cent of the ahead power.

The turbines are connected by flexible couplings to nickel steel pinions, which engage with the main wheels on the propeller shafts. The gearing is of the double helical single-reduction type, having Vickers-Bostock-Bramley patented "enveloping" gear teeth. The gear wheels consist of cast iron centers with shrunk-on forged steel rims. Central bearings are fitted to the pinion shafts.

The shaft bearings for both turbines and gearing are supplied with forced lubrication, and the thrust blocks, which are of "Michell" type, are placed on the shafts close up to the gearing.

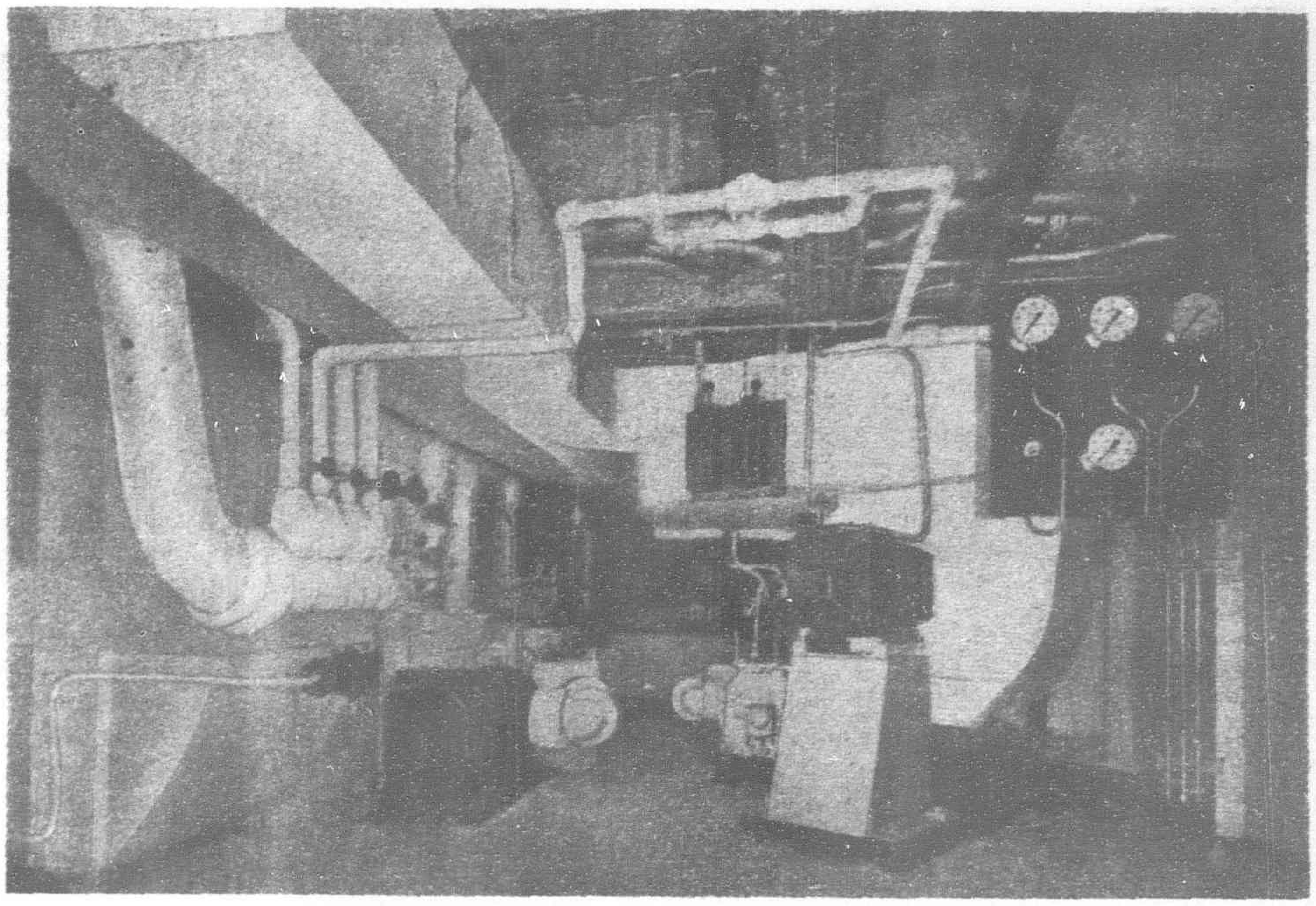
The propellers were supplied by J. Stone & Co., Ltd., of Deptford, and are of the built-up type, each having four blades of manganese bronze, secured to cast steel bosses by mild steel studs and gun-metal cap nuts, a cast iron cone being fitted over the propeller nut. Electrically operated turning gear is provided for the turbines and shafting.

The main condensers are of the Weir "Regenerative" pattern. They are suspended from the low-pressure turbine casings, and spring supports are fitted to relieve the load on the turbines. The total cooling surface in the condensers is 25,000 square feet. They are designed to maintain a vacuum of 28-in. of mercury with the barometer at 30-in., with a sea water temperature of 86 deg. Fah.

Boiler Installation

The steam generating installation consists of six Babcock and Wilcox type high-pressure marine boilers, all of which were built at Barrow. There are four large boilers and two small boilers, all fitted with superheaters and tubular air heaters. The boilers are constructed for a working pressure at the superheater outlet of 425 lb. per square inch, and a blow-off pressure of 450 lb. per square inch at the safety valves, the steam being superheated to 725 deg. Fah. The total generating surface of the four large boilers is 29,860 square feet, with a total superheating surface of 4,600 square feet. The total generating surface of the two small boilers is 7,170 square feet, with a total superheater surface of 1,350 square feet. The air heating surfaces for the large and small boilers are 32,000 square feet and 8,000 square feet respectively.

The boilers are arranged to burn oil only under the forced draught closed air duct system with open stokeholds. The necessary air is supplied to the boilers by five double-inlet electrically driven fans of Howden's manufacture.



Air conditioning plant for dining saloon and special cabins

The oil fuel installation consists of four units, each of which comprises one electrically driven pump and one heater, one pair working and one pair standby.

Two oil fuel transfer pumps of the electrically driven two-throw type, each with a capacity of 60 tons per hour for transferring oil to the settling tanks, are provided. Babcock Clyde soot blowers are fitted on the boilers and the air heaters.

The electric generating machinery comprises three main turbo-driven dynamos, each of 550 kw. at 220-volts, and one oil engine-driven generator of 90 kw. at 220-volts.

Electrical Generating Plant

The auxiliary generating plant in the *Orcades* consists of three turbo-generators and one emergency oil engine driven generator, all of which have been constructed by W. H. Allen, Sons & Co., Ltd., of Bedford.

The turbo-generators are installed in an auxiliary compartment forward of the main engine room. Each unit consists of a multi-stage steam turbine running at a speed of 5,000 r.p.m., driving a direct-current generator through double-helical gears, the generator speed being 500 r.p.m. The normal rated output of each machine is 550 kw. with an overload rating of 25 per cent for two hours.

The turbines are designed for operating at a steam pressure of 400 lb. per square inch gauge with a total temperature of 725 deg. Fah. and exhaust against a back pressure of 8 lb. per square inch gauge, or, alternatively, to a vacuum of 25-in. when the vessel is in port. Arrangements are made for bleeding steam from each turbine for feed heating purposes. The gears are enclosed in an oil-tight case, and are lubricated under pressure from the turbine oil system. The generators are of the compound-wound direct-current multi-polar type, designed for a voltage of 220.

The emergency generating set consists of a six-cylinder, 135 b.h.p. Allen four-cycle, airless-injection oil engine directly coupled to a D.C. generator, giving an output of 90 kw. when running at a speed of 500 r.p.m. In order to comply with Board of Trade regulations, the cooling water arrangement for the engine is self-contained. A radiator is provided through which the water circulates, and this is cooled by a fan driven off an extension of the generator shaft.

Instant starting of the oil engine from cold is effected by means of compressed air, and a Lister-Hamworthy auxiliary air compressor for charging the air bottle is provided. The auxiliary switchboard fitted in the emergency generator room was designed by W. H. Allen, Sons & Co., Ltd. This switchboard is connected with the main boards, and is also arranged to supply the special emergency circuits. The main distributing boards in the generating room were designed and supplied by Whipp and Bourne, Ltd., of Castleton, near Manchester.

Refrigerating Plant

The insulated cargo spaces in the Nos. 1, 2, and 3 holds and 'tween decks, have a total insulated capacity of about 212,000 cubic feet. The ship's provision chambers, of about 17,500 cubic feet, are situated on "J" deck, immediately abaft the cargo spaces. In addition to the main provision chambers, a series of cold cupboards in the galleys and lower bars, also milk-making machines, are cooled by brine from the main refrigerating plant. The plant is also used in connection with the air conditioning of the main public rooms.

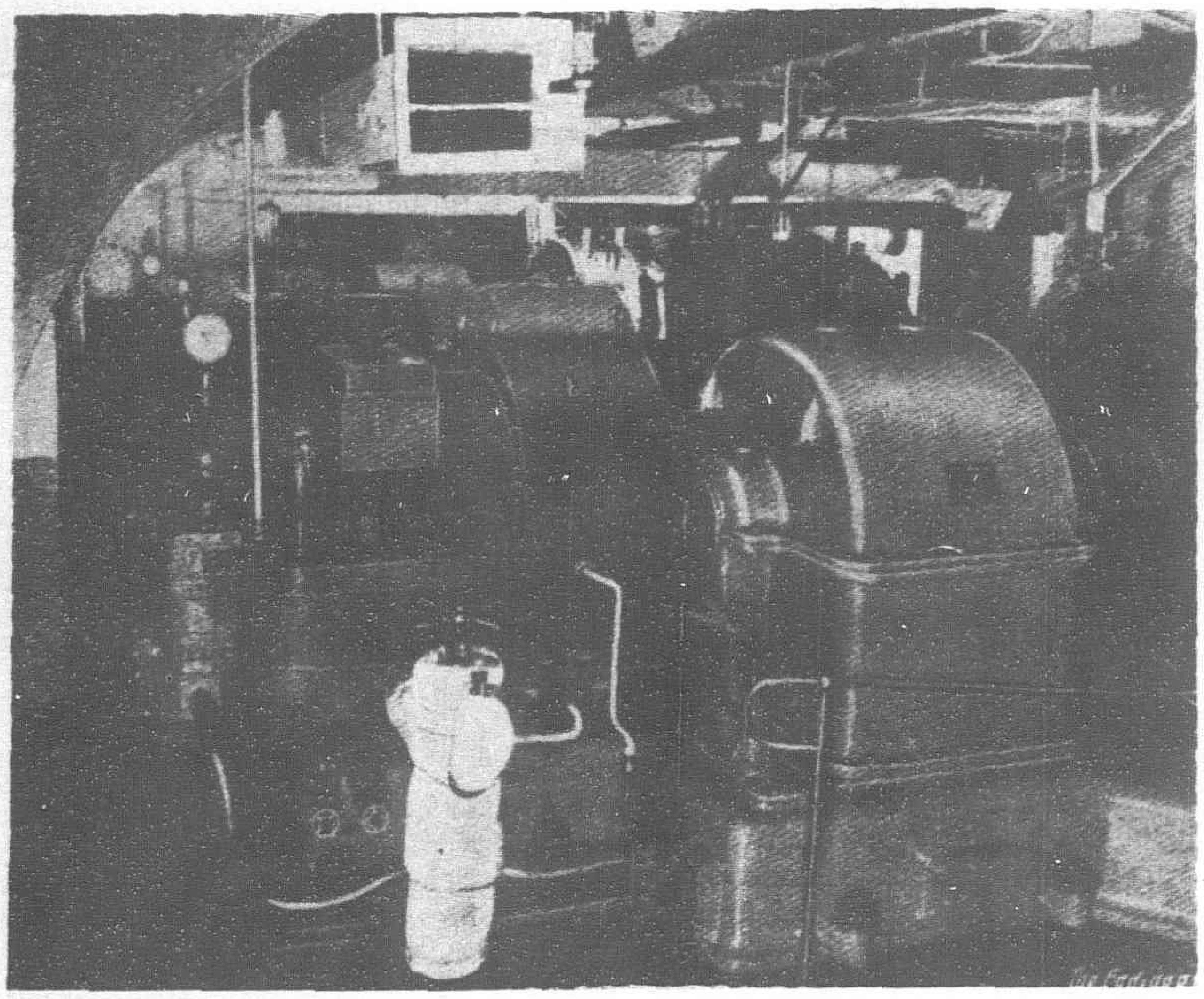
The refrigerating machinery, which was designed and fitted in the ship to the owner's requirements by J. and E. Hall, Ltd., of Dartford, is arranged in a room on the tank top, forward of the boiler rooms. It comprises four of the firm's latest type of twin-compressor horizontal CO_2 machines as illustrated, each driven by an Allen variable-speed electric motor of 125 b.h.p., coupled to its crankshaft. All the working parts are enclosed, and there is forced lubrication to all the principal bearing surfaces. Three machines are available for the cargo and provisions duty, two of the machines being powerful enough to maintain the required temperatures, the third machine being a standby. The fourth machine is used for cooling the water delivered to the air-conditioning plant. Cross connections are fitted so that one of the other three machines can be transferred to air-conditioning duty if required. There are four circular CO_2 condensers, three brine evaporators along with two fresh water evaporators. Electrically driven centrifugal pumps are fitted for circulating sea water through the CO_2 condensers and brine and fresh water through the evaporators. The brine arrangements are designed for the simultaneous circulation of brine at several different temperatures, as may be required for the various classes of cargo.

The No. 1 hold and 'tween decks, being mainly intended for the carriage of frozen goods, are cooled by brine grids fitted on the overhead and sides. The Nos. 2 and 3 holds and 'tween decks have brine grids on the overhead, and, in addition, there are brine batteries and fans to provide cooled air circulation for the carriage of frozen meat and fruit. The Nos. 2 and 3 'tween decks are arranged for the carriage of chilled beef, and are made gas-tight so that CO_2 injection can be used.

Air-conditioning Plant

Following the success of the air-conditioning plant designed and fitted by the Carrier Engineering Company, Ltd., of 24 Buckingham gate, London, S.W.1, in the sister liner *Orion*, it was decided by the Orient Line to equip the *Orcades* with a much more extensive installation. In this ship, not only is conditioned air supplied to the first-class dining saloon, the library, and the hairdressing saloon, but also for the first-class special cabins. She is, we are informed, the first British liner to have air conditioning applied to state rooms.

There are four main plants which are designed to meet the requirements of the dining saloon, the library, the special cabins, and the hairdressing saloon respectively. Conditioned air is also supplied to a specially designed cigar store, which has been built

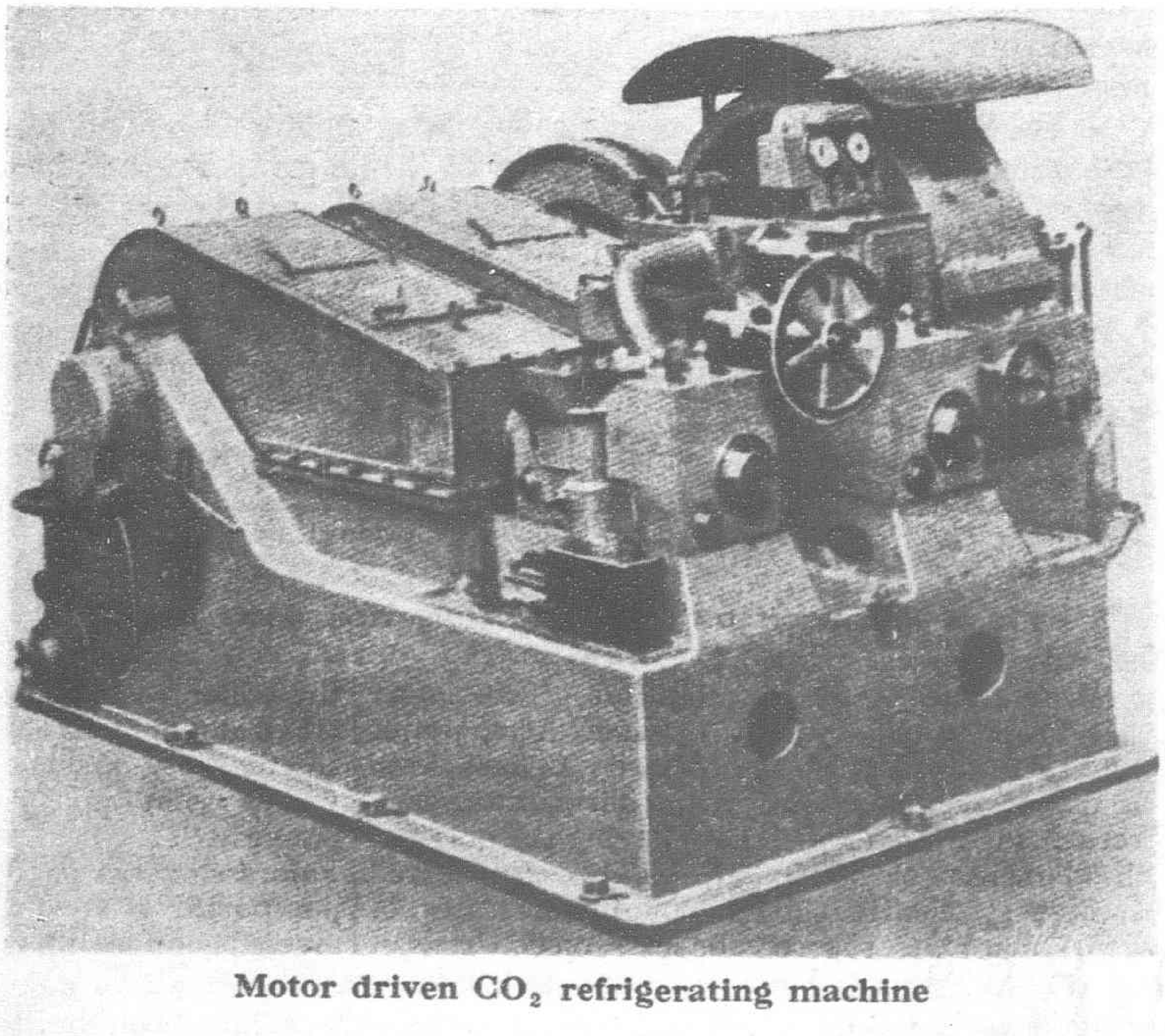


Turbo-generator machinery

in order to protect the cigars from deterioration under tropical weather conditions.

The owners required the plant to be designed to maintain comfortable internal condition in all the spaces served by it under the most tropical weather conditions met with in the Red Sea on the voyages to and from Australia, and on special cruises. The whole of the air delivered to the rooms is washed and its temperature and humidity is automatically controlled. In the cabins special consideration was given to the silent operation of the plant and the delivery of the conditioned air to the rooms silently and without draught. The plants have been designed not only to provide comfortable conditions of temperature and humidity in warm weather, but also heat and humidification in cold weather, thereby eliminating the somewhat harsh atmosphere which is often unavoidable with ordinary hot air heating.

To the left is the large machine for the dining saloon. In the fore-ground will be seen the main air supply fan and the dehumidifier. The entering air is drawn down a vent shaft at the far end of the machine, and during cooling it is passed through a very fine mist produced by atomising sprays, which are supplied with cooled water from the refrigerating system. After passing through the cool mist, the air reaches a series of metal eliminating blades, the object of which is to remove all free moisture. The air is again reheated to the desired temperature, and is then distributed to the dining saloon through a series of continuous louvres, placed in the ceiling of the room, which are designed to give a uniform flow of air with freedom from draught. The library is served by a similar machine, which is accommodated in a space on "A" deck.



Motor driven CO_2 refrigerating machine

To the right of the engraving will be seen the smaller machine, for the service of the special cabins, fourteen in number. It embodies the same principle of operation, with the exception that the distribution of the conditioned air to the cabin spaces is effected by a patented form of Carrier diffuser outlet, designed to give a silent and draughtless flow. This plant also serves the requirements of the special cigar store. The air in the first-class hairdressing saloon is dealt with by two small units which are arranged in the vent shafts.

Pumping Plant

The cooling water for the main engine condensers is supplied by two "Allen" steam turbine-driven circulating pumps, each of which is mounted on a combined cast iron base plate. Each unit consists of a horizontal centrifugal pump, having 30-in. branches, and is designed to deliver 16,000 gallons of water per minute against a total head of 21-ft. when running at a speed of 425 r.p.m. The pump casings are of cast iron, the impellers of gun-metal, and the shafts of manganese bronze. The pump is driven through speed-reduction gears by a single-stage, high-pressure "Allen" steam turbine of 130 b.h.p., running at 4,250 r.p.m., designed for a steam supply of 400 lb. per square inch gauge superheated to 725 deg. Fah., and exhausts against a back pressure of 8 lb. per square inch gauge.

A large number of auxiliary motor-driven pumps were supplied by W. H. Allen, Sons Co., Ltd., of Bedford, and that firm was also responsible for a large number of electric motors and controllers for the various auxiliary machinery. The pumps connected with the feed system were supplied by J. and G. Weir, Ltd., of Cathcart, Glasgow, and we noted that in the case of the pumps for harbor duty, reciprocating pumps have been done away with in favor of steam turbine-driven and motor-driven pumps.

In this short description we have only mentioned some of the many auxiliaries and parts of the machinery equipment, which, in the main, is like that of the *Orion*. The lay-out and arrangement was designed by Mr. J. Peacock, the owner's superintendent engineer, and Mr. F. Walker, the naval architect, who worked closely with the technical staff of Vickers-Armstrongs, Ltd., in the successful completion of one of the outstanding liners of the present year.

The China Hong List

The China Hong List for 1938 is now on sale. The work, of about 880 pages, follows the lines of previous issues, being divided into four sections—Shanghai business hongs, etc., China outports and interior cities, Manchoukuo cities, and Protestant and Catholic Missions. The dislocation of mail services for some weeks in the early autumn, due to the Sino-Japanese hostilities, made difficult the work of getting the required information, but the obstacles seem to have been well surmounted, and much valuable information finds a place within the volume.

Turning to the Shanghai section one sees evidence of the disastrous effect of the present war upon the business life of the city, and among the victims the Japanese business houses seem to have suffered equally with other nationalities. The disappearance—at least for a time—of many smaller Japanese firms, and the reduced staffs of the banks and some of the prominent business concerns demonstrate very clearly that war is not a profitable game for the majority of business men, while the effect upon the trade of the Chinese and upon that of firms of other nationality is also demonstrated by a survey of the work.

Notwithstanding these facts, and the difficulties which these have presented to those entrusted with the work of compiling, the 1938 Hong List will be found invaluable as a reference work both in the office and the home.

Other information given includes a full list of the diplomatic and consular officials in China, a list of mercantile marine officers on coastal and riverine steamers, and details of the British and U.S. navies on the China Station, together with the Foreign and Chinese calendars and festivals, the Jewish calendar, and the Shanghai Race Club's fixtures for the year.

The Hong List is issued at $10, and copies are now on sale at the offices of the publishers, North-China Daily News & Herald, Ltd., and at all leading bookstores.

Coast and Geodetic Work in Philippine Progress

(Reprinted from The American Chamber of Commerce Journal)

The Philippine coastline is many times that of the United States. With most of their interprovincial traffic, their commodity commerce especially, carried by sea, and their comprehensive ocean commerce, the work of the U.S. Coast and Geodetic Survey service has been of the most vital importance to their progress. Begun in September, 1900, about 87 per cent of the first survey of the waters of the Islands has been completed, and a triangulation control system has been executed to cover the entire archipelago. Associated with the following notes from Captain Maher, at present the bureau's director, the reader is provided a small but very accurate map of the islands.

* * *

THE Philippine Archipelago consists of 7,083 islands and rocks above water. Of this number 466 are islands with areas of one square mile or more. Thirty of these have areas of over one hundred square miles. The greatest length, north to south of the Archipelago is 1,150 statute miles and the greatest breadth is 660 miles. The approximate land area of the Islands is 114,400 square miles, 94 per cent of which is contained within the eleven largest islands of the group.

The Philippine Commonwealth is an island nation. Its interisland waterways are its great arteries of commerce. Railroads and roadways are only feeders. Its magnificent marine highways —lanes of commerce, cost nothing to build and nothing to maintain. The only cost is that of mapping and marking them. The wealth and progress of the Islands depend on the ease and facility with which its natural resources can become parts of the commerce of the world, and these depend entirely on the adequacy of the means of transportation and communication.

The commerce which creates the wealth of the Islands is water borne. Hemp, tobacco, sugar, minerals, all must be shipped. All must pass over some ports of waterways before they become the credits which represent the wealth of the Commonwealth.

The actual and potential wealth of the Islands, lies in the developed and undeveloped natural resources, but the greatest asset is the system of interisland waterways, the connecting links which join the hundreds of islands of the Commonwealth with the markets of the world, the marine highways which afford the only means for unlimited unrestricted transportation and communication. Highways free from fog, ice and many dangers which restrict navigation elsewhere.

The actual contribution of this great asset to the prosperity of the Commonwealth is difficult to estimate in pesos. A realization of its great value can only be grasped, inadequately after a consideration of the expense incurred elsewhere in constructing substitutes. Where such natural highways do not exist, man has had to construct more roads than would otherwise be necessary.

Are these great marine highways safe for navigation ? Have they always been safe ?

A table of statistics lists seventy-four vessels of over 1,000 tons as having been wrecked in Philippine waters from 1904 to 1914. To-day we seldom hear of a vessel going aground on an uncharted rock. What has been done to make these waters safe ? Over two hundred and eighty thousand square miles of water area have been surveyed ; over 8,000,000 soundings have been taken ; 165 charts have been published. Five survey ships were kept in operation, under Federal direction for over thirty years, surveying these waters. The cost from 1901 to June 30, 1937, has been $9,817,780 of which $5,619,524 has been contributed by the Federal government and $4,198,256 by the Insular and Commonwealth governments. The maximum expenditures in any one year were in 1928 when the Federal government contributed $209,139 and the Insular government $144,509.

Expenditures during 1936 were—Federal, $48,135 ; Commonwealth, $74,021 ; 1937—Federal, $52,918 ; Commonwealth, $105,056.

Territorial limits need to be accurately defined so as to permit adequate patrolling to prevent smuggling of aliens, drugs and other contraband. Also, international complications may be more easily avoided and territorial neutrality maintained when the limits of jurisdiction are accurately determined.

The question which will naturally be asked by any one interested in this subject is—Will the surveys of the waters of the Commonwealth be completed when the remaining 13 per cent are charted ? The answer is no. Deep draft vessels are displacing shallow draft interisland craft. Deep draft, ocean going ships are calling direct for cargo at places formerly visited, if at all, by small craft. This practice will increase rather than diminish.

During the first ten years of the operation of this Bureau, to meet the demands of shipping, surveys had to be made at such a rate, that with the methods then in use, they do not fully meet the standards demanded by modern shipping. The most important waters were surveyed first. These waters have not lost their commercial importance. It is evident that revision of charts will be necessary for many years.

A revision of the Coast Pilot is now in progress, under the direction of an officer detailed from Washington. One-third of the work has been completed. The results will be published in two volumes, superceding the issue of 1930. The Coast Pilot is a publication giving sailing directions, data regarding tides and currents, details regarding the security of anchorages, harbor regulations, availability of supplies and other information required by the navigator, but of such character that it cannot be given on the charts.

In other words, these volumes supplement the charts. The work is being done on a co-operative basis, the Commonwealth furnishing a seagoing launch and crew for transportation.

Plans have been under consideration for the training of young men to take over the work performed by and under the direction of Federal officials. The training of field men offers a more serious problem than the direction of office activities. Provision was made for the appointment of three cadets, but facilities for training them are lacking. With only one small ship in operation, the steamer *Fathomer*, federal survey officers would have to be removed to provide quarters for the students and it is doubtful, at the present time, if a further curtailment of surveys is warranted, even for such a worthy purpose. The officials of the Commonwealth are considering means to remedy this difficulty.

The plant of the Manila Office of the Coast and Geodetic Survey is a fully equipped unit for converting the work of its field parties into the finished charts, and maps used by the navigator, aviator, engineer and the public in general. It is a duplicate of the Washington office of the Bureau, but on a smaller scale, being furnished with the necessary instruments, cameras and presses. It prints and publishes 165 charts for the mariner, three maps for the aviator and 19 topographic and outline maps.

During the past year it compiled and printed 37,000 maps for other Bureaus of the Commonwealth, some of these maps having as many as twenty-one colors. During the same period the photographic section handled ninety-four jobs for other bureaus. The number of charts printed in 1936 was 27,286, an increase of 11,300 over the number printed in 1922. The number of maps issued in 1936 was 3,047, only 696 having been issued in 1922. These figures are not only indices of the increase in shipping but of the commercial development of the country, as the maps go to those interested in inland or interior projects, mining, agriculture or engineering.

It will be seen that activities which have been dormant for many years are coming to life. That demands by other entities are rapidly making the plant the map printing bureau of the Commonwealth, thereby fully utilizing a skilled personnel and avoiding the duplication of equipment.

The formation of the islands is such that the triangulation which forms the backbone of the marine surveys, can be readily used as the basic control for such systems of land surveys as agriculture and mineral development will make necessary. This will result in a savings of at least one half million pesos on the cost of such control.

The tidal and current observations of the organization are not only of value to mariners but to the Bureau of Science in making investigations of the migration of fish and in other studies, for which purpose the great number of salinity and water temperature observations taken by field parties are of great use. The records on file in the archives of the Bureau are in constant use by mariners and engineers and in legal actions. Much of the mineral wealth now being developed is coming from areas known in Spanish times. In fact old records on file in the Manila Office of the Coast and Geodetic Survey have been in such demand, that for their preservation against wear, it has been necessary to reproduce them in the form of an atlas.

The bureau is an important source of information to marine, commercial and scientific interests and provides worth while returns on the small expenditures required for its maintenance.

Engineering Notes

INDUSTRIAL

SOYA BEAN PRODUCT.—The South Manchuria Railway Company has decided to organize a subsidiary, capitalized at Y.10,000,000, to manufacture rayon pulp from soya bean husks. It is estimated that 250,000 tons of rayon pulp will be produced annually from about 1,500,000 tons of husks.

VISCOSE FROM SOYA HULLS.—With pulp prices steadily on the upgrade, the South Manchuria Railway Co. and the Mitsui interests announce plans for the creation of a Y.12,000,000 firm for the manufacture of viscose from the hulls of soya beans. The Toyo Rayon Co., and the Tokyo Rayon Co., will also invest in the venture.

KUALA LUMPUR BUILDS.—Buildings aggregating over two million dollars are going up in Kuala Lumpur. The latest contract is for the new Overseas Chinese Bank, which will be one of the tallest buildings fronting the Old Market Square. Other big jobs are the $700,000 police depot, the $360,000 extensions of the Sultan's Astana in Klang, the $250,000 central market and new office buildings for Harrisons, Barker & Co., Ltd.

SMOKE ABATEMENT.—A massive steel chimney, the largest of its kind in Shanghai, is to be constructed to diffuse into the air the sulphurous fumes emerging from the power plant. The cost is estimated at $450,000, and if the stack succeeds, two others will be erected. Last summer and autumn, Power Company experts carried out experiments with water washers, but it was evident that no benefit would be obtained from them. In addition, the fitting of washers would be so costly that it would probably entail an increase in the municipal rates. The giant steel chimney was finally decided upon.

JAPAN SODA EXPANSIONS.—The Japan Soda Company is reported to be planning expansion and merges which will make it a Y.200,000,000 firm within the year. Japan Soda has widened its activities to include production of many kinds of chemicals, in addition to soda. It also has undertaken the manufacture of iron, copper, nickel and other metal products, and is producing coal. Among the firms' industrial activities are steel manufacturing, machine and tool manufacturing, rayon pulp and staple fibre making. The company also has money in projected enterprises for aluminium manufacturing, petroleum production, gunpowder making and electric power generation. Japan Soda will establish the Nisso Rayon Pulp Company and has also decided to take over the Kureha Spinning Company.

POOTUNG WATERWORKS.—The $700,000 Pootung Waterworks has begun functioning. The plant has a net output of 3,000,000 gallons a day. Construction was begun in September, 1935, by the Greater Shanghai City Trust.

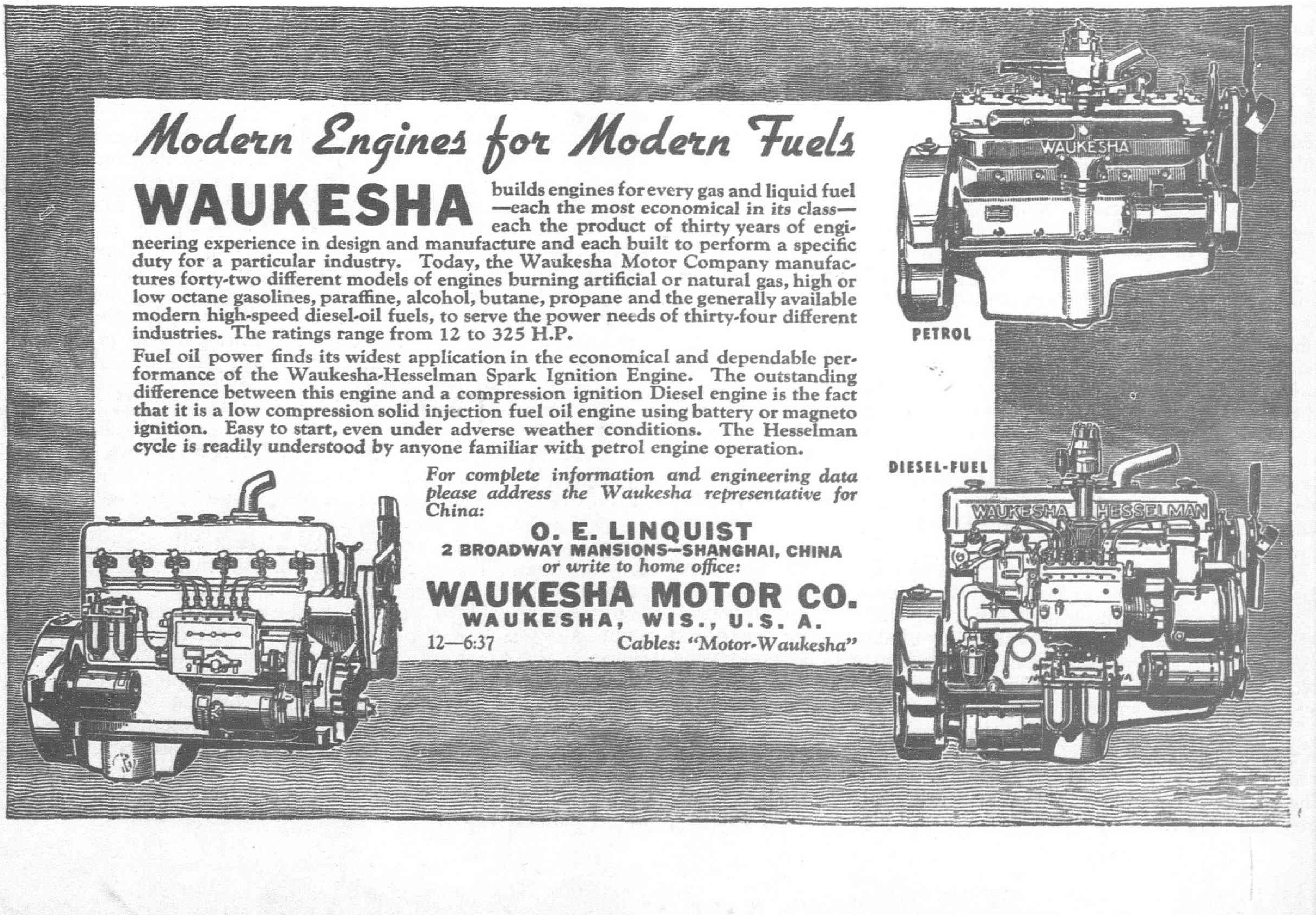
NEW BANK DOOR.—Over thirty tons, comprising the highly-complicated door of the vault of the new Bank of China, has been moved into the Shanghai Bund's latest skyscraper. Weighing over 60,000 lb., the vault door, made in the United States, is 9-ft. 11-in. long, 8-ft. 4-in. wide, and 5-ft. 8-in. in height. It is calculated to baffle the most scientific-minded robbers.

FIVE YEAR PLAN.—The Tokyo Ministry of War has submitted to the Planning Board of the Cabinet the draft of an industrial five-year plan, which will cost Y.9,000,000,000. The Ministry desires that the plan will be inaugurated in 1938, with the aim of tripling by 1943 the industrial capacity of the Japanese Empire, which, it is estimated, totalled Y.12,000,000,000 last year.

SHANGHAI METAL INDUSTRIES.—The formation of a new firm, to be known as the Metal Industries of China, Ltd., is contemplated in Shanghai, with an authorized capital of $10,000,000. The objects are in particular to import ships as a means of acquiring their component metals, machinery and other materials, a business which has been carried on by the China Ship-Breakers, Ltd., since 1933. In addition to the profitable rolling of steel bars, the meeting of a ready demand for all forms of iron and steel and a similar demand for non-ferrous metals of all kinds, there are numerous uses to which the product of old ships is put locally and, it is claimed, even in times of normal steel supply, the ship-broken product can be produced more cheaply than that imported. The first directors of the concern are Messrs. G. E. Marden, F. R. Davey, Ellis Hayim, Song Vung-kwe and O. T. Steen; the bankers are the Hongkong and Shanghai Banking Corporation and the National City Bank of New York. Messrs. Wheelock & Co. are secretaries and general managers.

RADIO

RADIOPHONE.—The China—U.S.A. radiophone service was formally opened on May 19. The service is now available for public use twice a day.



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